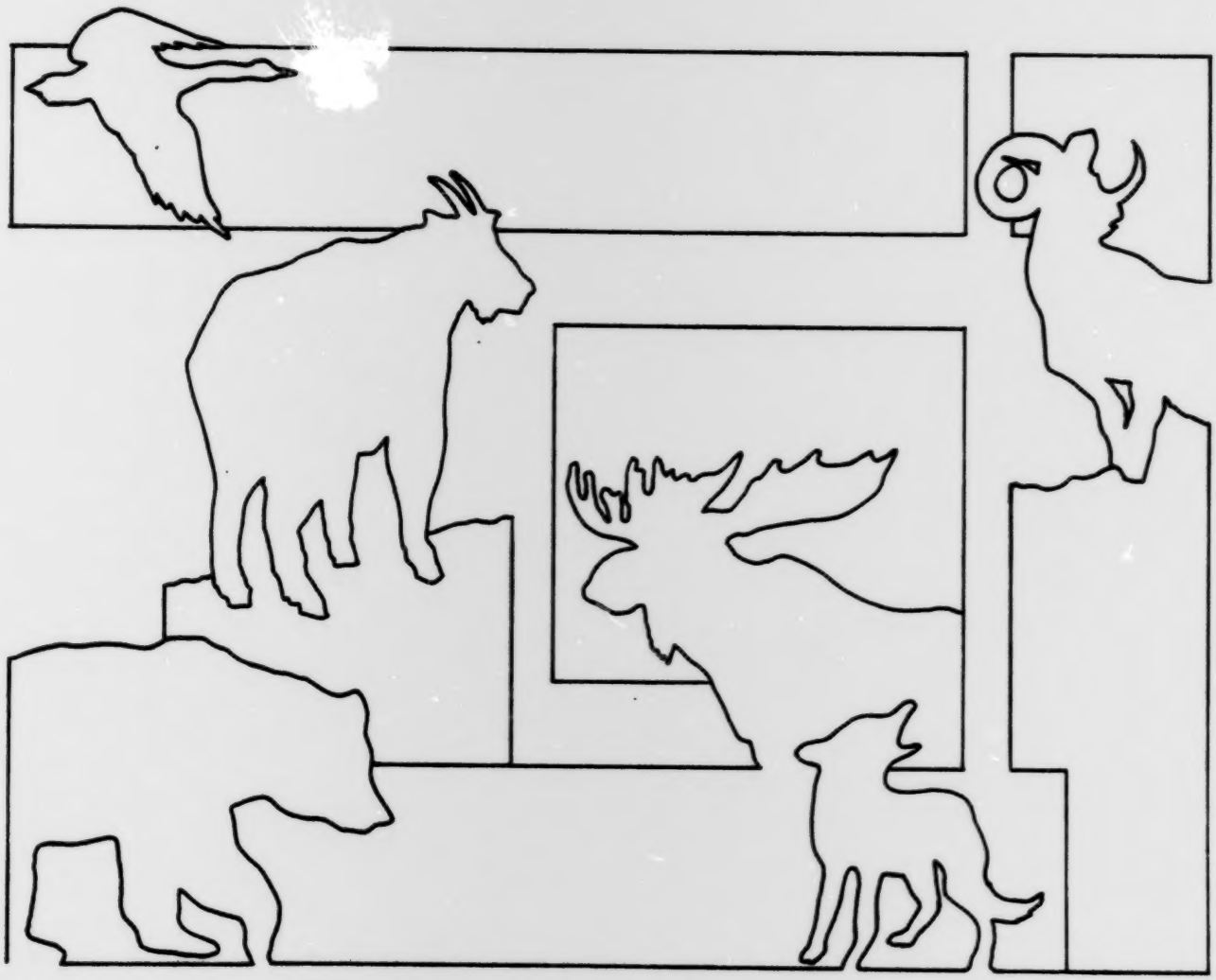
WILDLIFE

Inventory of Canada Geese and Other Waterfowl Within the Yukon River Basin

Project Report : Wildlife No. 5b



YUKON RIVER BASIN STUDY

This project was completed for the Yukon River Basin Study, an intergovernmental study funded by the governments of Canada, Yukon and British Columbia.

Environment Canada

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Canadian Wildlife Service
Pacific and Yukon Region

INVENTORY OF CANADA GEESE AND OTHER WATERFOWL WITHIN THE YUKON RIVER BASIN

June - August 1983

by

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Cathy Macpherson meticulously drafted all figures. The typed manuscript was prepared by Kelly Wilkinson and the Bionic Secretary.

SUMMARY

Investigations of Canada Geese and other waterfowl breeding and moulting on rivers of the Yukon River Basin were conducted from early June to mid-August during 1983. Ground surveys were conducted on the Morley, Swift and Teslin Rivers and their associated wetlands in June and again in July and August. Two aerial surveys, one each on 16 June and 17 July, were conducted on the Stewart, Pelly and MacMillan Rivers.

The study objectives were:

1. to assess the distribution and abundance of Canada Geese and other waterfowl on the rivers and associated wetlands;

2. to identify and describe areas of the rivers important to Canada Geese and other waterfowl.

Canada goose populations (including young of year) on the surveyed sections of the Morley, Swift and Teslin Rivers in June were 30, 99 and 303 geese respectively or 0.6, 1.0 and 6.1 geese/km of river. Young of the year represented 33, 30 and 17% of the respective populations.

More geese were observed during the July and August surveys than during the June surveys. On the Morley, Swift and Teslin Rivers maximum goose numbers were 121, 276 and 401 respectively, or 2.47 2,87 and 8.07 geese/km.

Breeding pairs of geese were most abundant on the Teslin river (14 pairs) as compared with 8 on the Swift River and 3 on the Morley River. Most geese on the rivers were failed breeders or non-breeders.

Goose distribution along the rivers tended to be dispersed in June and more clumped in July and August. This was most noticeable on the Morley and Swift Rivers. Most sections of the rivers were used by geese

during June. During the June survey most geese (50%) on the Morley River occurred as pairs while most geese on the Swift and Teslin Rivers (43 and 81% respectively) occurred in groups of three or more birds. The same was found during the second surveys on the Swift and Teslin Rivers while on the Morley River most geese (84%) occurred in creches or mixed nursery groups.

Only two Canada Goose nests were located: one on a wetland and one on a river bank. The initiation of Canada Goose nesting was estimated to have occurred in early to mid May and hatch to have occurred from early to mid June based on aging six broods.

Goose brood-rearing was restricted to the river course. Non-breeders used both the river course and river valley wetlands. The wetlands used by geese were predominantly large wetlands classed as Shallow Waters. These were characterized by an expansive area of open water, a wide rim of emergent vegetation and extensive submergent vegetative growth. On the rivers many geese were associated with shore bars and backwaters. These habitats were most extensive and available during July and August when river water levels had decreased. Bars and backwaters offered loafing and feeding areas with good visibility to geese.

Plants noticeably grazed by geese included grasses, sedges, rushes and an emergent hydrophyte, mare's tail. Specific plants included: Carex rostrata, Arctophila fulva, Calamgrostis canadensis, Poa pratensis, Glyceria borealis, and Juncus balticus.

Identified goose moulting areas within the ground surveyed study area included Swift Lake, where 200 geese were counted, and Hutsigola Lake and neighbouring wetlands where 220 geese were observed. Moulting geese on the Morley River were restricted to the river course.

Non-breeding geese commenced moulting by late June and had finished

by early August. Breeding geese evidently initiated the moult in early July as most were capable of flight by the second week of August.

Among the rivers aerially surveyed, Canada Geese were most abundant on the Stewart River. During 17 June, estimated goose populations on the rivers were: 129 geese on the Stewart River, 73 on the Pelly River and 21 on the MacMillan River, or 0.40, 0.48 and 0.20 geese/km of river, respectively. The June estimates of goose abundance were higher than estimates from mid-June 1982, however July 1983 estimates were lower than the June estimates of the same year and lower than mid-August 1982 estimates. The unusually low goose abundance noted during July 1983 was likely due to poor survey conditions.

Paired geese were not abundant on the rivers on 17 June. Seven pairs were noted on the Pelly River and four on the Stewart River. The only evidence of successful breeding were two broods, one each on the Stewart and Pelly Rivers, during the June survey. However, more young of the year were noted in July (26 on the Stewart River and 6 on the Pelly River) than in June.

During the mid June survey, when river water levels were high, geese on the Stewart and Pelly Rivers occurred predominantly on the river channel. The two geese groups on the MacMillan River were associated with shore bars and backwaters. By mid-July, most geese noted on the Stewart and Pelly Rivers were utilizing backwaters.

The Stewart and Pelly Rivers, and to a lesser extent the MacMillan Rivers provided moulting areas for local populations of Canada Geese. River backwaters were used for moulting once these areas had become available, a function of the seasonally reduced river water levels. Equisetum spp. was prolific at the backwaters and were grazed by Canada Geese.

For all of the rivers surveyed, the dynamic process of seasonal river water level fluctuations appears critical to Canada Geese utilizing the rivers. Spring flood waters deposit materials on the river edge while the summer decrease in water levels exposes bar areas, thus providing loafing and feeding areas for geese.

Other than Canada Geese, waterbirds within the valleys of the Morley, Swift and Teslin Rivers were not abundant. Minimum estimates of waterbird pair densities were 16.6, 5.1 and 6.2 pairs/km^2 of wetlands on the Morley, Swift and Teslin Rivers respectively, which corresponded to 25, 22, and 21 pairs. The more common waterbird breeding pair species were: American Wigeon, Green-winged Teal, Lesser Scaup and Ring-necked Duck.

Brood density was greater than breeding pair density on all rivers but the Morley. Brood density on the Morley, Swift and Teslin Rivers was 3.31, 8.41 and 8.30 broods/km^2 of wetlands, respectively, or 5, 36 and 27 broods. Common brood species included: American Wigeon, Green-winged Teal and Lesser Scaup.

Non-breeders or failed breeders were abundant on the river wetlands. Minimum estimates of the average densities of non-breeders on the Morley, Swift and Teslin Rivers were: 24.17, 61.21 and 27.67 non-breeders/km^2 of wetlands, respectively, corresponding to 73, 524 and 179 non-breeders. The more abundant non-breeder species were: Mallard, American Wigeon and Lesser Scaup.

Most of the wetlands sampled had sparse submergent plant growth. Some of the more common emergent macrophytes were: Carex rostrata, Equisetum fluviatile, and Hippuris vulgaris. Common submergent macrophytes included: Sparganium spp., Potamogeton spp., Ranunculus spp. and Myriophyllum spp.

Among the wetlands sampled in the Morley River valley, 52% were classed as Marsh, 37% as Shallow Water and 11% as Fen. In the Swift River valley 70% of the wetlands were sampled as Shallow Water, 15% as Marsh, 11% as Fen and 4% as Lake. The composition of wetlands sampled in the Teslin River valley was: 56% Shallow Water, 33% Marsh and 11% Fen. Waterbird distribution among the wetland types did not differ significantly from the expected distribution, among all rivers.

Waterbird abundance on the river courses was generally low. Common Mergansers were common to all rivers. The Teslin River had the poorest species respresentations (5 species) on its channel and the Swift River had the greatest (10 species).

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INTRODUCTION

This project was funded by the Yukon River Basin Study, a joint government committee (federal, territorial and provincial) established to sponsor studies investigating components of the biological, physical and socio-economic environment of the Yukon River Basin. Northern Biomes Ltd. was contracted by the Canadian Wildlife Service (CWS) in 1982 (Johnston and McEwen 1983a) and again in 1983 to conduct baseline inventory investigations of nesting, brood-rearing and moulting waterfowl with special focus on Canada Geese (Branta canadensis) within the Yukon River drainage.

Concern has been expressed for the need to identify and investigate important waterfowl areas within the Yukon River Basin. Hartman and Hayes (1980) expressed concern over the potential loss of riparian habitat in the Yukon which could jeopardize the productivity of local populations of Canada Geese. The Canadian Wildlife Service (1981) and Theberge et al (1980) identified regions of specific river systems as potentially important waterfowl breeding areas and suggested ground surveys be conducted to verify the significance of these areas.

Prior to this study, little information existed on Canada Geese and other waterfowl utilizing rivers of the Yukon River drainage (east of the Alaska border). Early bird studies (Rand 1946, 1950; Soper 1954) serve merely to give a general overview of birds recorded in specific localities. More recent documented waterfowl studies in the Yukon River Basin have been undertaken in response to specific hydro-electric and pipeline developments (Sigma Resources Consultants Ltd. 1975; Foothills Pipe Lines (Yukon) Ltd. 1977a, 1978; Canadian Wildlife Service 1979; Anweiler and Blood 1981).

In 1982, Northern Biomes Ltd. conducted intensive ground surveys of Canada Geese and other waterfowl on the Big Salmon and Pelly Rivers, as well as overview aerial surveys on these rivers and the Stewart River (Johnston and McEwen 1983a). During the 1983 field season, intensive surveys were conducted on the Morley, Swift and Teslin Rivers. In addition, aerial surveys were carried out on sections of tts of the 1983 study.

The objectives of this study were:

1. to assess the number and distribution of Canada Geese and other waterfowl species utilizing the Morley, Swift and Teslin Rivers through ground surveys

2. to identify and document important areas for nesting, brood-rearing and moulting of Canada Geese and other waterfowl on the Morley, Swift and Teslin Rivers

3. to determine the extent and describe the biophysical attributes of areas utilized by geese

4. to assess the relative importance of the Morley, Swift and Teslin Rivers for breeding and moulting of Canada Geese;

5. to assess the use of the Stewart and Pelly Rivers by moulting Canada Geese during 1982 and 1983, and to present a preliminary evaluation of Canada Goose use of the MacMillan River.

STUDY AREA

The study area encompasses the Stewart, Pelly and MacMillan Rivers of the central Yukon Territory and the Morley, Swift and Teslin Rivers of the south-central Yukon Territory and northern British Columbia (Figure 1). All rivers lie within the central drainage and upper headwaters of the Yukon River Basin.

Rivers can be ordered into one of five orders based on the number and type of tributaries they have. A first order river is one with no tributaries (at 1:250,000 scale mapping), a second order river has tributaries, a third order river has tributaries which are second order rivers and so on. Using this ordering system the Yukon River is a fifth order river. It is a large river, in fact the largest river system in the Yukon Territory, draining an area of 245,000 km^2. Its headwaters are a network of large, deep lakes in the southern Yukon and northern British Columbia. The Stewart and Pelly Rivers are fourth order rivers and both are major tributaries of the Yukon River (Figure 1). The Stewart River has an average width of 150 m and drains an area of approximately 51,600 km^2 (Government of Canada 1968). The Pelly River drains an approximate area of 51,800 km^2 (Government of Canada 1968) which includes the drainage of the MacMillan River, a third order river. The Morley River is a second order river. The Swift River is a second order river upriver of its confluence with the Smart River and a third order river downriver of this point. The Teslin River (above Teslin Lake) is a third order river. The Morley, Swift and Teslin Rivers flow via Teslin Lake into the Teslin River which is a major tributary of the Yukon River (Figure 1).

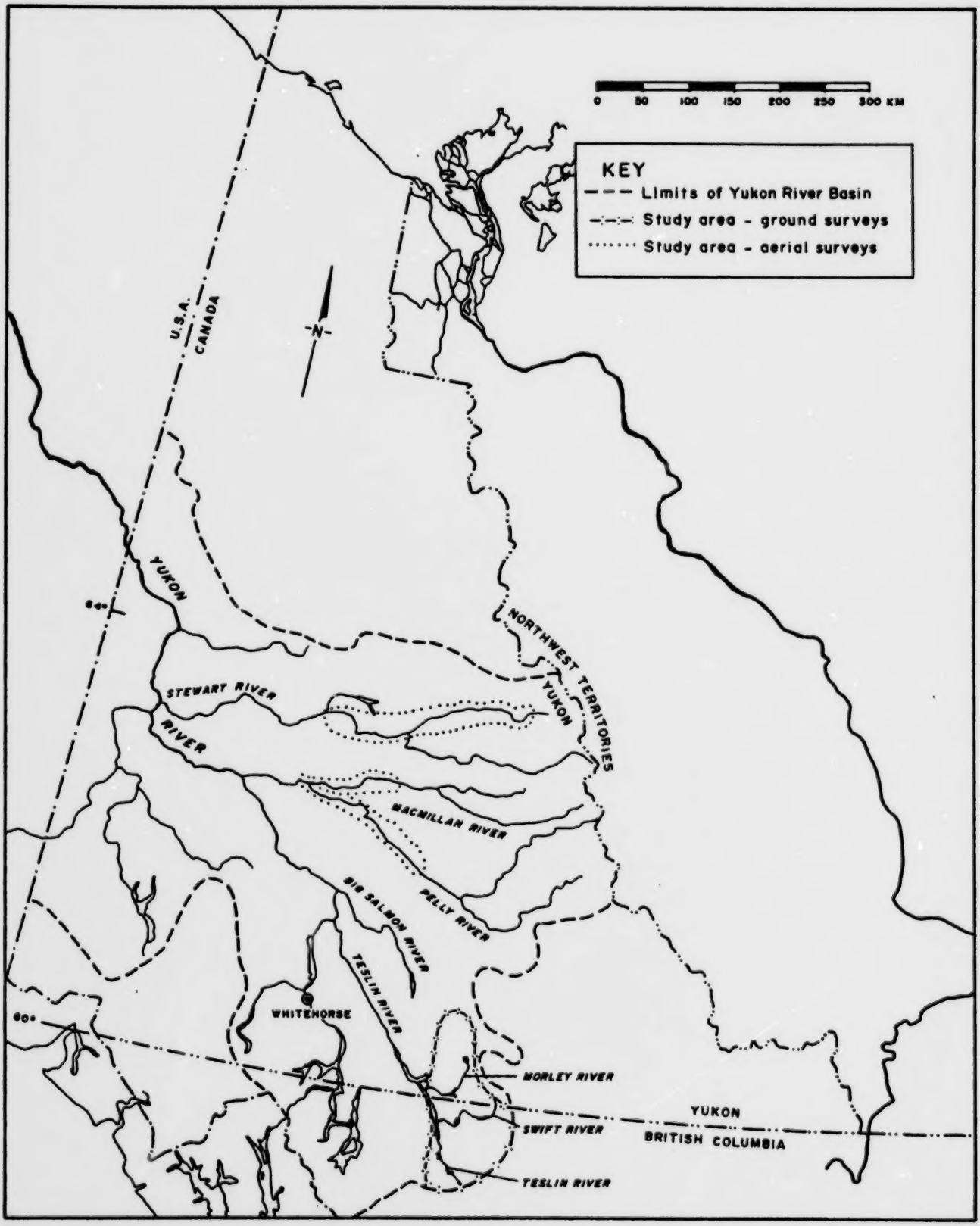

Figure 1 Study Area of Ground and Aerial Surveys

Aerial Survey Study Area

The Stewart, Pelly and MacMillan Rivers were surveyed for Canada Geese from low level aerial surveys. A description of this area is presented in Johnston and McEwen (1983a). The specific river sections surveyed were: the Stewart River from Ortel Creek to the townsite of Mayo, the Pelly River from Anvil River downriver to Granite Canyon, and the MacMillan River from south of the MacMillan forks to its confluence with the Pelly River.

Ground Survey Study Area

The Morley, Swift and Teslin Rivers lie at elevations of 610 m to 914 m, with surrounding areas of the watershed ranging to 1524 m in elevation. The area lies in the Boreal Forest Region (Rowe 1972). Characteristic tree species include lodgepole pine (Pinus contorta) and White spruce (Picea glauca) with occassional stands of trembling aspen (Populus tremuloides). Black spruce (Picea mariana) occurs on poorly drained lowlands. Flood plains as a rule are narrow and river valleys contain little balsam poplar (Populus balsamifera). The area is within the southern limit of permafrost. The weather is characterized by Pacific Coast systems which tend to have a cooling effect in summer and a moderating effect during the winter (Kendrew and Kerr 1955).

Morley River

The Morley River was surveyed from Slim Lake, 49 km downriver to Morley Lake (Figure 2). Access was by float plane. Beyond Morley Lake the river continues approximately 30 km to Morley Bay on Teslin Lake. This river section below Morley Lake was not surveyed.

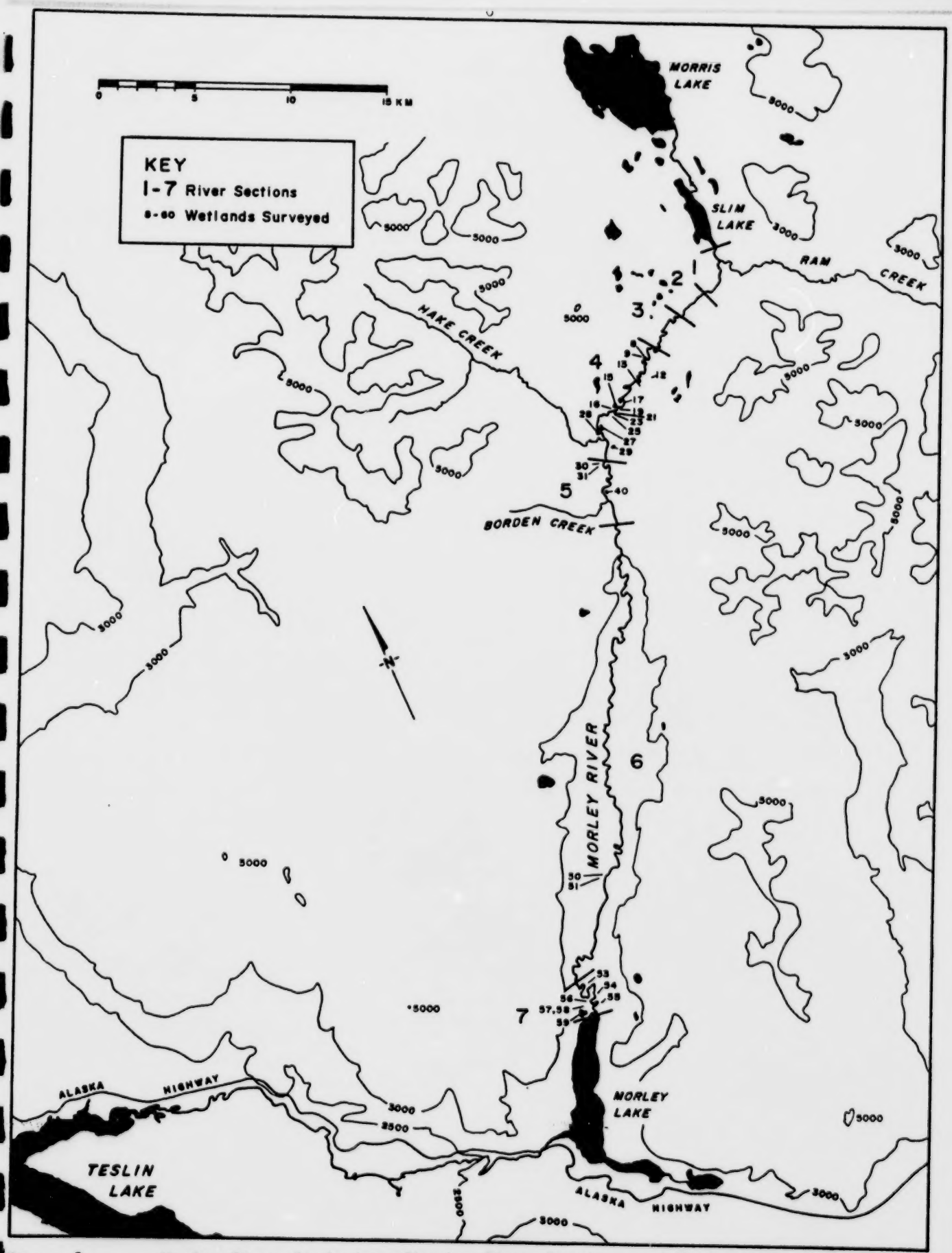

Figure 2 Morley River Study Area Showing River Sections and Wetlands Sampled

No known hydrological data is available for the Morley River. From our experience, water levels were highest prior to 7 June and flooding of the river's banks was most evident in the upper 20 km of the river. Rapids and standing waters were encountered at numerous points along the river. Extensive boulder fields were numerous throughout the river and were most evident during low water levels. Treed islands occurred in the upper river sections. Fifty wetlands were identified within the river study area.

Swift River

The Swift River was surveyed from its intersection with the Alaska Highway, where it was accessed, 95 km downriver to Swift Lake (Figure 3). Within the study area, 5 km of river immediately downriver from the Smart River mouth were omitted as they were not considered navigable. The Swift River continues from Swift Lake 23 km to its mouth at Teslin Lake, however, this section was not surveyed because of unnavigable water.

Spring and early summer water levels on the Swift River were highest on 2 June (Water Survey of Canada, Whitehorse records). River valley wetlands in the study area totalled 157.

Teslin River

The Teslin River study area included the 50 km of river from Chismaina Lake down river to Hutsigola Lake (Figure 4). Access was by float plane. The broad Teslin River valley contrasts with the more narrow valleys of the Morley and Swift Rivers. Wetlands are numerous throughout the river valley. Within a 2 km corridor either side of the river, 100 wetlands were enumerated.

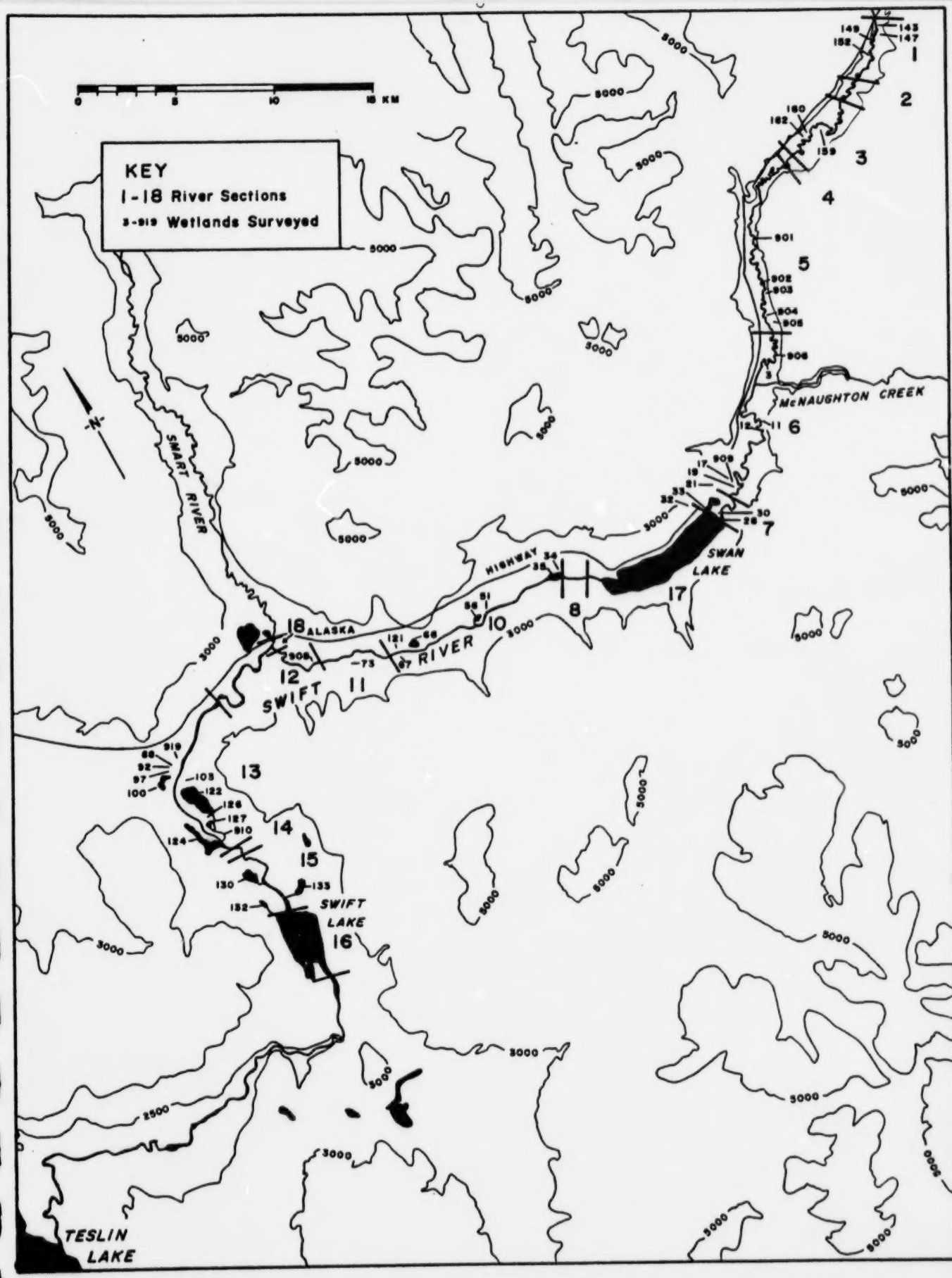

Figure 3 Swift River Study Area Showing River Sections and Wetlands Sampled

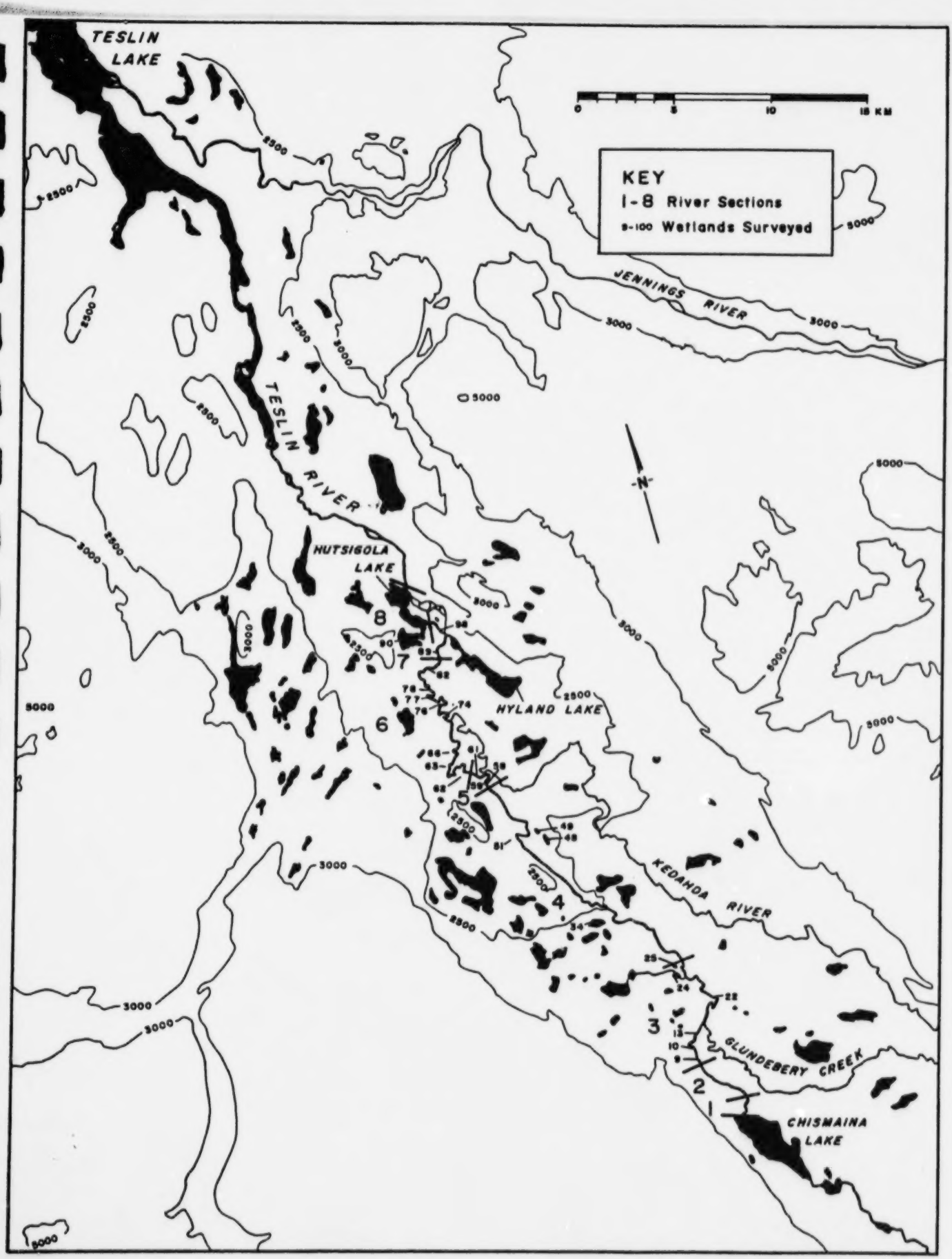

Figure 4 Teslin River Study Area Showing River Sections and Wetlands Sampled

METHODS

Gound Surveys

River Course

To determine the distribution and abundance of Canada Geese and their associated habitat, ground surveys were conducted on the Morley, Swift and Teslin Rivers from June to August 1983. Each river was surveyed twice, once in June for evidence of Canada Goose nests and early brood-rearing areas and again in July and August for evidence of moulting and late brood-rearing areas (Table 1). Surveys were conducted by two observers travelling in a paddle canoe. River channels and the river valley wetlands were surveyed for the presence of or evidence of use by Canada Geese.

TABLE 1. Schedule of River Ground Surveys, June - August 1983.

RIVER	SURVEY DATES	
	Trip 1	Trip 2
Morley River	7 - 11 June	30 July - 1 August
Swift River	12 - 19 June	17 - 21, 28 - 29 July
Teslin River	23 - 29 June	6 - 10 August

In order to aid in the definition and analysis of habitat use by Canada Geese, each river was subdivided into discrete sections, based on apparent gross differences in habitat. This partitioning was done on-site while conducting the surveys. The criteria used were obvious changes in river width, current, numbers of meanders, presence or absence of rapids, immediate valley width and surrounding vegetation.

The boundaries of each river section were marked onto the aerial photos which were being used to aid navigation and which also offered the most detailed available mapping of the rivers.

For each river section a number of measurements were taken. Surface current (m/second) was estimated from the mean value of three measurements of the length of time required for a marker buoy to travel 25 m downriver in the current at mid-river. River width (metres) was approximated from the aerial photos. The meander index was the ratio of the true river length between the upriver and downriver boundaries of each river section to the straight line distance between the same two end points. Wetland density was the number of delineated wetlands within a given river section.

All Canada Goose and other waterfowl observations were recorded with the associated river section number. A unique number was given to each Canada Goose sighting and the location was marked on the aerial photos. Bird group type (pair, brood, creche, single, flock), behaviour, group size, age and sex composition, moult stage, immediate habitat, and age of young were recorded whenever applicable. Goslings were aged using the classification of Yocom and Harris (1965). Ducklings were aged according to the conventions of Gollop and Marshall (1954).

The number of breeding pairs of Canada Geese was estimated three ways: (1) a count of only those pairs observed during the June survey with a clutch or brood, (2) all pairs counted with a brood or clutch in addition to all territorial pairs during the June surveys, (3) the total number of young counted during the second survey divided by the calculated mean clutch size ($\bar{x}$=4, determined from all broods noted during all three river surveys in June) to give an estimate of the number of individual broods each of which had two parents. Each of these methods is expected to under-estimate the true number, because each fails to take into account failed breeders (that were not re-nesting). Density estimates of geese are presented as number of geese per linear kilometer of river.

Goose habitat was described by the vegetation type present in the vicinity of each observation and the area's morphological association with the river, such as: vegetated bar, backwater, shore bar or mudflat. All areas which showed evidence of goose use (grazing, faeces, tracks, feathers) were described and recorded. When identification of specific plants could not be made, sample specimens were collected for identification at the Biosystematics Research Laboratory in Ottawa.

All bird names follow the most recent A.O.U. (1982) checklist. A list of all birds observed in the Morley, Swift and Teslin river systems is presented in Appendix 1. Mammal sightings are also appended (Appendices 2, 3, 4).

Wetlands

Prior to conducting ground surveys, aerial photos of the river valleys were examined. All wetlands in the immediate river valley were delineated and numbered. Due to the broad width of the Teslin River Valley, only those wetlands within 2 km of the river course were enumerated. An estimate of the area of each wetland, to the nearest hectare, was obtained using a dot grid. Wetlands were classified as large ($\geq$5 ha), medium (2-4 ha) or small ($\leq$1 ha).

River valley wetlands were visited once during each survey. Waterfowl observations were made by one or two observers, each equipped with 7x35 binoculars, who independently walked or paddled the wetland periphery or zone of emergent vegetation. All waterfowl observations were recorded with the appropriate wetland number. Waterfowl group type, age, sex and behaviour were noted.

A duck's group type (breeding pair, non-breeder) was assessed using some of the conventions of Dzubin (1969). A breeding pair was identified by a lone pair, a lone drake, or a hen on a nest or with a brood. Other than a lone Bufflehead hen, a lone hen was not considered a breeder. Ducks in groups of two or more birds (which were not obvious pairs) were considered non-breeders.

Wetlands were classified according to the wetland organization of the Canadian Wetland Registry (Zoltai 1980), with the addition of "Lake" as a wetland type. The wetland classification scheme is general and designed to classify areas for national comparisons. Due to the scheme's national application we felt it was suitable to our needs as it encompasses most of the wetlands likely to be encountered during wetland surveys in the Yukon Territory and northern British Columbia.

The vegetation of each wetland was sampled within the following lifeform zones: submergent, floating-leaf and emergent. The dominant plant species present within each life form zone, and a visual estimate of their percent cover within a $1m^2$ plot were recorded. Sedges and grasses and all unidentified plant species from both the wetlands and the river were sent to the Biosystematics Research Laboratory in Ottawa for identification. Plant nomenclature follows Porsild and Cody (1980).

Aerial Surveys

Aerial surveys of Canada Geese were conducted on sections of the Pelly, MacMillan and Stewart Rivers, on 16 June and again on 17 July during the moulting season. Surveys were restricted to sections of the rivers which had been identified as important to Canada Geese from surveys conducted in 1982 (Johnston and McEwen 1983a). As no geese were observed on the valley wetlands during surveys of the Pelly and

Stewart Rivers in 1982, only the river channels were surveyed in 1983. The low level, aerial surveys were conducted in a fixed-wing aircraft, Cessna 206, at 50-100 m agl, at approximately 160 kph. The pilot plus one front seat navigator/observer and one or two back seat observers were present. Goose numbers, group type, group size, behaviour, location and habitat distribution were recorded onto cassette tape. The locations of goose observations were marked on 1:250,000 scale topographic maps.

RESULTS

Rivers and Associated Wetlands - Biophysical Habitat

Morley River

The Morley River was divided into seven sections (Figure 2) varying in length from 1.7 - 27.8 km. River sections 1, 2 and 6 had the highest surface velocities (Table 2). The comparatively slow river sections, sections 4, 5 and 7, shared the higher meander index ratings and the higher wetland densities (Table 2).

River water levels varied between the two survey periods, being higher during the June survey. The seasonal reduction in water levels caused the elimination of rapids and standing waves in section 1 and the exposure of extensive boulder fields, particulary in section 6. Shore bars became exposed along the river's edge with decreased river water levels and backwaters became distinct from the river course.

Grasses, rushes and sedges noted along the river course during the August survey included: Arctagrostis arundinacea, Arctophila fulva, Calamagrostis canadensis, Deschampsia caespitosa, Carex aquatilis, Carex physocarpa and Juncus balticus (Appendix 5). The aquatic macrophyte, Hippuris vulgaris was very common along the river course during the August survey.

Wetlands in the Morley River valley had a clumped distribution. Most of the wetlands occurred in river sections 4, 5 and 7 where the river meanders (Figure 2). Among the 50 total wetlands identified in the Morley River valley, few or none occurred in sections 1, 2, 3 and 6. More than 50% of the river valley wetlands were small ($\leq$1 ha), as were most (59%) of the sampled wetlands. The large wetlands ranged in area from 5-30 ha. Most of the wetlands (52%) were typed as Marsh, 37% as Shallow Water and 11% as Fen. The total area of wetlands sampled was 151 ha.

TABLE 2. Physical Attributes Measured for Sections of the Morley, Swift and Teslin Rivers. June - August 1983.

RIVER SECTION	SECTION LENGTH (km)	SURFACE VELOCITY (m/s)	RIVER WIDTH ($\bar{x}$) (m)	MEANDER INDEX	WETLAND DENSITY (#/km)
MORLEY					
1	2.6	2.4	20	1.5	0.0
2	2.6	2.4	17	1.3	0.0
3	3.0	NV	17	1.8	0.0
4	7.2	1.2	25	2.0	4.0
5	4.0	1.6	33	2.6	3.3
6	27.8	2.8	33	1.4	0.4
7	1.7	1.4	30	2.0	4.7
TESLIN					
1	0.9	0.2	68	1.3	0.0
2	2.9	1.7	25	1.5	0.7
3	8.9	1.7	34	1.7	2.0
4	15.0	1.1	34	1.3	2.0
5	3.0	1.1	25	2.4	1.3
6	11.2	1.0	34	2.2	2.1
7	2.6	0.3	34	1.3	2.7
8*	5.2	NV	NA	1.3	2.7
SWIFT					
1	6.7	1.8	21	1.9	0.4
2	1.8	1.9	21	1.7	0.0
3	8.8	1.4	42	2.3	0.7
4	0.1	NV	21	1.0	0.0
5	17.5	1.3	27	1.8	0.4
6	12.6	1.7	9	2.2	0.9
7	3.1	1.2	11	2.0	1.9
8	1.4	NV	8	1.0	0.0
10	12.4	1.2	17	1.1	0.8
11	4.3	2.8	9	1.1	0.9
12	3.0	1.8	8	1.2	0.3
13	9.0	0.5	84	1.1	2.0
14	0.5	4.2	32	1.0	0.0
15	4.5	1.0	99	1.3	0.7
16*	3.0	0.0	NA	NA	0.0
17*	7.0	0.0	NA	NA	0.0
18*	0.4	0.0	NA	NA	0.0

* Lakes
NV No Value
NA Not Applicable, Lake Sections

Among the sampled wetlands, 74% had apparently been flooded by the high, spring river water levels. Most of the wetlands had little submergent macrophyte growth which may be a consequence of rigorous spring flooding. The more common emergent plant species in the wetlands included Carex rostrata, Hippuris vulgaris, Carex aquatilis and Equisetum fluviatile. The frequent occurrence of Hippuris vulgaris was not found on the other two rivers surveyed (Table 3). Commonly occurring submergents included Sparganium spp., Ranunculus aquatilis, and numerous species of Potamogeton (Table 3).

Swift River

The Swift River was segregated into 17 sections (Figure 3). The first seven sections, above Swan Lake, were comparatively narrow and characterized by numerous meanders (Table 2). Wetlands were not numerous and most were small and immediately adjacent to the river. Below Swan Lake the river becomes wider and straighter and treed islands occur occasionally. The straightest and widest river sections with the slowest surface currents were sections 13 and 15. The greatest wetland density was also in section 13 (Table 2). This section contained very large wetlands (35 - 114 ha) which were contiguous to the river (Figure 3).

The Swift River water level in late spring and early summer was highest on 2 June in 1983 (Appendix 6). Water levels thereafter decreased. Approximately 50% of the sampled wetlands were flooded by early June high waters. During high waters, the confluence of the Smart and Swift Rivers (section 18) formed a 1m deep backwater, yet by 19 July the backwater was dry. Decreased summer river water levels exposed and extended shore bars and gravel bars in many places.

TABLE 3. Frequency of Occurrence of Aquatic Hydrophytes Recorded During Surveys of Wetlands of the Morley, Swift and Teslin Rivers, June - August 1983.

SPECIES	% FREQUENCY OF OCCURRENCE		
	MORLEY	SWIFT	TESLIN
Equisetum fluviatile	35	6	41
E. palustre	9	3	-
E. pratense	9	3	-
Arctophila fulva	-	6	-
Carex aquatilis	35	15	29
C. rostrata	83	50	76
Calla palustris	-	-	6
Hippuris vulgaris	43	6	-
Menyanthes trifoliata	-	-	6
Polygonum amphibium	-	-	12
Nuphar spp.	9	-	12
Potamogeton alpinus	17	6	-
P. Porsildiorum	4	-	-
P. filiformis	13	29	6
P. Friesii	22	9	-
P. gramineus	4	-	-
P. pectinatus	13	-	-
P. praelongus	9	15	29
P. Richardsonii	13	18	12
P. vaginatus	9	3	-
Sparganium spp.	70	41	53
Ranunculus aquatilis	35	47	18
R. reptans	17	9	-
R. Gmelini	9	15	24
Callitriche spp.	4	9	12
Myriophyllum spp.	13	47	18
Utricularia vulgaris	4	9	18
*Chara**	17	9	6

* green algae

Within the Swift River study area, 173 wetlands were enumerated, of which 26% were sampled. These wetlands cumulatively represented an area of 428 ha. Most (70%) of the wetlands were typed as Shallow Water, 15% were Marsh, 11% were Fen and 4% were Lake.

The most frequently occurring emergent plant at the wetlands was Carex rostrata (Table 3). The more common submergent macrophytes included: Myriophyllum spp., Ranunculus aquatilis, and Sparaganium spp. Pondweed (Potamogeton spp.) was also common although the species representation varied among the wetlands.

Teslin River

The Teslin River was divided into eight sections (Figure 4). Sections 5 and 6 had the highest meander index, although not the highest wetland densities (Table 2). Shore bars, island bars and ephemeral gravel bars were extensive in these two sections. The highest wetland density occurred in sections 7 and 8 and the next highest in sections 3 and 4. Section 8 was principally Hutsigola Lake thus it was a unique section and not comparable to the other river sections. A delta effect occurs where the river flows into the lake.

Although present in June, shore bars were more extensive during the August survey as a result of the seasonally lower river water levels. Grasses, sedges and rushes noted along the Teslin River are listed in Appendix 5.

The Teslin River valley is very wide relative to the Morley and Swift River valleys and contains numerous large wetlands (Figure 4). For the purposes of this study, only wetlands within 2 km of the river course were surveyed. Cumulatively the sampled wetlands represented 325 ha. Most (56%) of the wetlands were Shallow Water, 33% were Marsh and 11% were Fen. Hutsigola Lake was a major Shallow Water wetland.

The more commonly occurring emergent wetland plants included: Carex rostrata, Equisetum fluviatile and Carex aquatilis. Sparganium spp. was the most common submergent noted (Table 3). Floating-leaved macrophytes (Nuphar spp. and Polygonum amphibium) were common in wetlands of the Teslin River.

Canada Geese

Morley River

Trip 1 (7-11 June)

A total of 30 Canada Geese were found on the Morley River in the 7-11 June survey period, of which 20 (67%) were $\geq$ 1 year old birds, and 10 (33%) were goslings from two broods (Table 4). The mean brood size was 5, and goslings from both broods were placed into age class Ia following the conventions of Yocom and Harris (1965). In addition, a nest with 3 eggs was found. Most of the birds $\geq$ 1 year old were paired, although 50% of the pairs were without a brood or nest. These latter geese were either non-breeders, or failed breeders.

The density of geese was 0.6 birds/km. The number of breeding pairs (birds with clutches or broods) averaged 0.06 pairs/km of river (Table 5), lower than the estimate based on territorial pairs or on the number of young during Trip 2.

Geese were distributed along the entire length of the river, except section 1 (Table 6 and Figure 5). Goose densities among the river sections ranged from 0.07 geese/km to 1.54 geese/km (Table 6). Wetlands on the Morley River were not used extensively by geese. The only geese observed on wetlands were one group of four (Table 7).

TABLE 4. Canada Goose Density and Age Composition on the Morley, Swift and Teslin Rivers. 1983.

	MORLEY	SWIFT	TESLIN
JUNE SURVEY			
total geese observed	30	99	303
total geese ≥ 1 yr old	20	69	250
total young observed	10	30	53
density of total geese (#/km)	0.61	1.03	6.10
density of geese ≥ 1 yr old (#/km)	0.41	0.71	5.03
% young of total	33	30	17
% breeders of total	20	16	9
JULY-AUGUST SURVEY			
total geese observed	121	276	401
total geese ≥ 1 yr old	95	228	337
total young observed	26	48	64*
density of total geese (#/km)	2.47	2.87	8.07
density of geese ≥ 1 yr old (#/km)	1.94	2.37	6.78
% young of total	21	17	16
% breeders of total	+	+	5*

* not determined in section 8
\+ could not be determined

TABLE 5. Density of Breeding Pairs of Canada Geese on the Morley, Swift and Teslin Rivers. 1983. Density is breeding pairs per km of river.

		MORLEY		SWIFT		TESLIN	
		# pair	#/km	# pair	#/km	# pair	#/km
I	Breeding Pairs (assoc. with a nest or brood)	3	.06	8	.08	14	.28
II	Breeding Pairs (as above plus territorial birds)	5	.10	9	.09	15	.30
III	Breeding Pairs *	6	.12	12	.12	16	.32

* $2x \left[\frac{\text{no. of young in Trip 2}}{\text{mean brood size}^{t}}\right]$

t $\bar{x}$ = 4, calculated from all broods noted in June on all rivers

TABLE 6. Morley River - Distribution of Canada Geese Among the River Sections, 1983. Densities expressed as number of geese/km of river.

		RIVER SECTIONS							
		1	2	3	4	5	6	7	TOTAL
RIVER LENGTH (km)		2.6	2.6	3.0	7.2	4.0	27.8	1.7	48.9
JUNE SURVEY									
broods	#	-	1*	-	-	-	1	1	3
	#/km		0.38*				0.04	0.59	0.06
geese	#	-	4	2	6	4	2	2	20
(≥ 1 yr old)	#/km		1.54	0.67	0.83	1.00	0.07	1.18	0.41
JULY-AUGUST SURVEY									
creches°	#	-	-	2	-	3	-	-	5
	#/km			0.67		0.75			0.10
geese	#	-	-	28	-	67	-	-	95
(≥ 1 yr old)	#/km			9.33		16.75			1.94

* pair with nest

° no creches observed during June survey, no lone broods observed during July - August survey

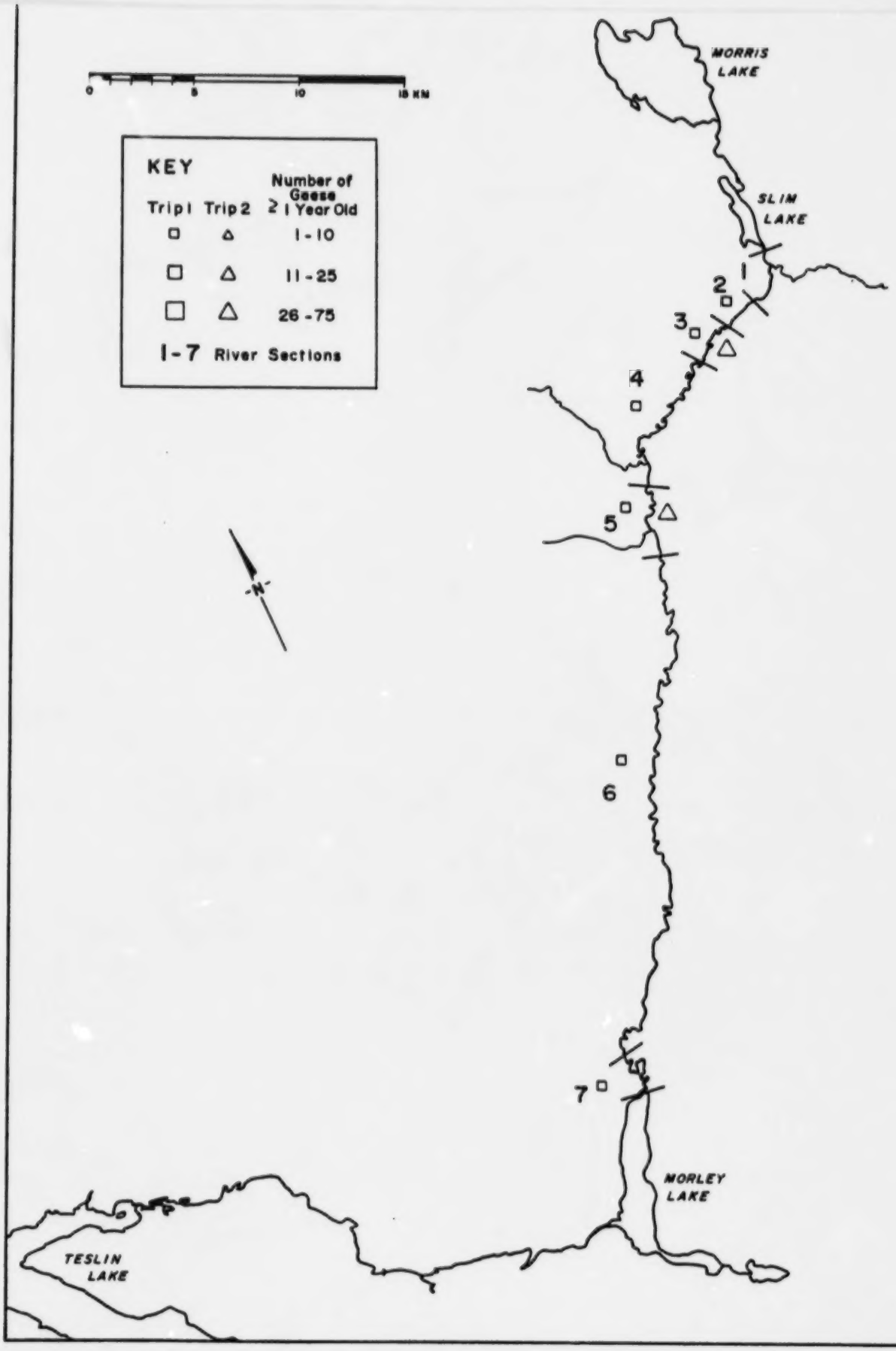

Figure 5 Canada Goose Distribution on the Morley River, June-August 1983

TABLE 7. Morley River - Comparison of the Distribution of Canada Geese on the Wetlands and River Course, 1983. Excludes young of year.

	WETLANDS		RIVER COURSE	
	No. of Individuals	% of Total	No. of Individuals	% of Total
JUNE SURVEY				
paired - with broods/nests	0		6	38
paired - no broods/nests	0		10	62
single	0		0	
creche	0		0	
group ($\geq$ 3 birds)	4	100	0	
total geese ($\geq$ 1 yr old)	4	100	16	100
JULY - AUGUST SURVEY				
paired - with broods/nests	0		0	
paired - no broods/nests	0		0	
single	0		0	
creche	0		80	84
group ($\geq$ 3 birds)	0		15	16
total geese ($\geq$ 1 yr old)	0		95	100

Trip 2 (30 July - 2 August)

A total of 121 geese were recorded during the 30 July - 2 August survey period, of which 95 (78%) were $\geq$ 1 year old and 26 (21%) were goslings (Table 4). Total goose density including goslings was 2.47 geese/km. Although the number of goslings had increased from Trip 1, they represented a smaller proportion of the total geese counted (Table 4). Most of the goose increase was due to geese $\geq$ 1 year old.

All of the geese were aggregated in groups or creches (Table 8). All goslings were in creches which ranged in size from 11 - 40 geese.

Geese were recorded at six separate locations, compared with 10 during the June survey. Goose distribution along the river was clumped (Figure 5 and Table 6). All geese occurred in only two sections (3 and 5) of the river which together represented 7 of the total 48.9 km. Densities within these two river sections were 9.3 geese/km and 16.7 geese/km respectively. No geese were observed in the wetlands.

Swift River

Trip 1 (12-19 June)

Canada Geese were more abundant within the Swift River valley than in the Morley River valley (Table 4). Ninety-nine geese were counted on the Swift River. The total goose density was 1.0 geese/km and the density of geese $\geq$ 1 year old was 0.7 geese/km.

Along the Swift River, 8 breeding pairs of geese (0.08 pair/km of river) were observed. Employing other estimate methods, breeding pair density could have been as high as 0.12 pair/km (Table 5). Among the observed pairs, only one had a nest. Birds with young represented 16% of the total geese counted on the river.

TABLE 8. Distribution of Canada Geese by Group Type on the Morley Swift and Teslin Rivers. 1983.

	MORLEY		SWIFT		TESLIN	
	No. of Individuals	% of Total	No. of Individuals	% of Total	No. of Individuals	% of Total
JUNE SURVEY						
paired - with nest/brood	6	30	16	23	14	6
paired - no nest/brood	10	50	20	30	10	4
single	0	0	3	4	3	1
creche	0	0	0	0	20	8
group ($\geq$ 3 birds)	4	20	30	43	203	81
total geese ($\geq$ 1 yr old)	20	100	69	100	250	100
JULY - AUGUST SURVEY						
paired - with nest/brood	0	0	3	1	6	2
paired - no nest/brood	0	0	2	1	2	1
single	0	0	0	0	1	<1
creche	80	84	13	6	13	4
group ($\geq$ 3 birds)	15	16	210	92	315	93
total geese ($\geq$ 1 yr old)	95	100	228	100	337	100

The 30 young represented 30% of the total geese counted (Table 4). Mean brood size was 3.9 young. However, the number of broods on the Swift River was almost three times the number on the Morley. Brood age was estimated to be age Class Ia.

Broods were encountered within six of the river sections (Table 9). Given that the river was divided into 17 sections and there were only seven broods, a comparison of the availability and the use of the various sections was not possible.

Brood density for the entire river length surveyed as 0.08 brood/km. Only two breeding pairs (one with a nest and the other with a brood) were located in the wetlands.

Most (70%) of the geese $\geq$ 1 year old were found at and downriver of the confluence of the Smart and Swift Rivers (i.e. sections 13, 14, 15, 16 and 18). In contrast, most of the broods occurred upriver of this point (Table 9).

Thirty-three percent of the geese $\geq$ 1 year old were found on wetlands. Most of these geese were grouped and were found on large, shallow water wetland types, specifically wetlands #100, #124 and #130 (Figure 3).

Most of the geese counted in the Swift River were in groups, unlike the Morley River where most of the geese were paired (Table 8).

Trip 2 (17-21, 28-29 July)

By July, Canada Goose numbers had increased 179% since Trip 1. The increase was attributed to both an increase in young of the year and geese $\geq$ 1 year old (Table 4). Non-breeding geese were responsible for much of the increase. A group of 200 geese on Swift Lake (Figure 6)

TABLE 9. Swift River - Distribution of Canada Geese Among the River Sections, 1983. Densities expressed as number of geese/km of river.

		RIVER SECTION																	
		1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	TOTAL
RIVER LENGTH (km)		6.7	1.8	8.8	.1	17.5	12.6	3.1	1.4	12.4	4.3	3.0	9.0	0.5	4.5	3.0	7.0	0.4	96.1
JUNE SURVEY																			
broods	#	2*	-	-	-	1	2	-	-	1	-	1	1	-	-	-	-	-	8
	#/km	0.30*				0.06	0.16			0.08		0.33	0.11						0.08
geese	#	4	-	3	-	2	10	-	-	2	-	-	19	4	8	2	-	15	69
(∑ 1 yr old)	#/km	0.60		0.34		0.11	0.79			0.16			2.11	8.00	1.78	0.67		37.5	0.72
JULY SURVEY																			
broods	#	-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	4
	#/km					0.17	0.08												0.04
creches°	#	-	-	-	-	1	-	1	-	-	-	-	-	-	1	-	-	-	3
	#/km					0.06		0.32							0.22				0.03
geese	#	-	-	-	-	8	-	2	-	-	-	-	-	-	18	200	-	-	228
(∑ 1 yr old)	#/km					0.46		0.65							4.00	66.67			2.37

* includes 1 pair with a nest
° no geese in creches during June survey

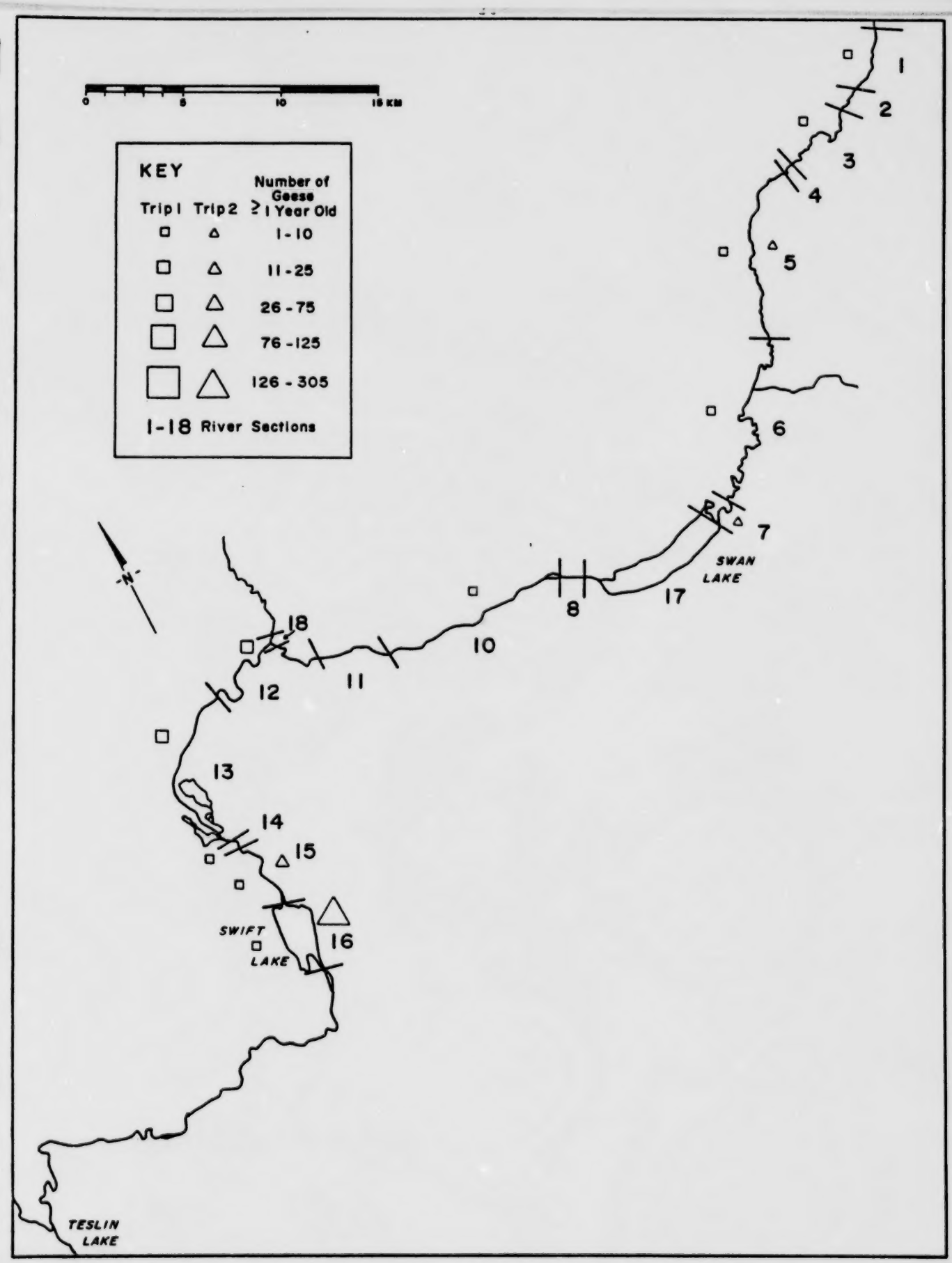

Figure 6 Canada Goose Distribution on the Swift River, June-August 1983

comprised 72% of the total geese. As these geese did not flush in response to aircraft they were likely moulting. Other than this large group no other geese occurred on the wetlands (Table 10).

Canada Geese on the river course were associated in creches (46%) and groups (36%). A few geese occurred as individual pairs, either with or without broods (Table 10). Overall, most of the geese ($\geq$ 1 year old) occurred as groups, unlike geese on the Morley River where most were in creches (Table 8).

The distribution of geese on the Swift River in July was clumped (Table 9 and Figure 6). Most of the non-breeders occurred in river sections 15 and 16 while most of the broods and creches occurred above Swan Lake. Although the use of the different river sections between the breeders and non-breeders was also noted during Trip 1, their distribution then not as clumped.

Young of the year represented 17% of the total geese counted. Most of the young occurred in creches. Creches ranged in size from 10-18 geese with 8-15 young.

Teslin River

Trip 1 (23-29 June)

The Teslin River supported the greatest number of breeding pairs (14) and the greatest density (0.28 pr/km). Other methods of calculating the density of breeding pairs yielded even higher density estimates (Table 5). Despite the abundance of breeding geese, they represented only 9% of the total adult geese counted (Table 4). This contrasts with results from the Morley and Swift River in which breeding geese represented a larger proportion, 20% and 16% respectively, of the total adult geese.

TABLE 10. Swift River - Comparison of the Distribution of Canada Geese on the Wetlands and River Course, 1983. Excludes young of year.

	WETLANDS		RIVER COURSE	
	No. of Individuals	% of Total	No. of Individuals	% of Total
JUNE SURVEY				
paired -with broods/nests	2	9	14	30
paired -no broods/nests	4	17	16	35
single	1	4	2	5
creche	0	0	0	0
group ($\geq$ 3 birds)	16	70	14	30
total geese ($\geq$ 1 yr old)	23	100	46	100
JULY - AUGUST SURVEY				
paired -with broods/nests	0		3	11
paired -no broods/nests	0		2	7
single	0		0	0
creche	0		13	46
group ($\geq$ 3 birds)	200	100	10	36
total geese ($\geq$ 1 yr old)	200	100	28	100

The Teslin River supported the highest number of goslings although they represented only 17% of the total geese counted. Goslings were observed in seven broods and three creches.

If the adults in each creche are assumed to be all parents and their numbers divided by 2 to represent the number of pairs involved and thus the number of broods, then the goslings in the three creches represented 7 broods and thus there was the equivalent of 14 broods.

Brood size ranged from 3-4 goslings ($\bar{x}$ = 3.6). Goslings were aged into age classes Ic and IIa. Broods were found in only two river sections, sections 3 and 6 (Table 11). Creches tended to be in the downriver sections of the river (sections 5, 6 and 8).

The density of geese ($\geq$ 1 year old) was 5.03 geese/km. This value was substantially higher than values on the Morley and Swift Rivers (Table 4). Most (73%) of these geese counted were non-breeders.

Most (81%) of the geese $\geq$ 1 year old were associated in groups (Table 8). Group type differed between the geese on wetlands and on the river course. Although grouped geese were the predominant type on both the wetlands and the river course, 30% of the geese on the river course occurred as single pairs while only 1% of geese on the wetlands occurred as pairs (Table 12). Creches were observed both on the wetlands and the river course.

The greatest density of geese ($\geq$ 1 year old) was in river section 8, at Hutsigola Lake (Table 11 and Figure 7). There geese ($\geq$ 1 year old) totalled 153 individuals. On the basis of goose numbers per unit area, the density was 102 geese/km^2. Most of the geese in this river section were represented by three groups of 13, 48 and 61 individuals and were non-breeders. Eleven other adults occurred in a creche. Sections 7 and 5 also had high goose densities of 9.23 geese/km

TABLE 11. Teslin River - Distribution of Canada Geese Among the River Sections, 1983. Densities expressed as number of geese/km of river.

		RIVER SECTION								
		1	2	3	4	5	6	7	8	TOTAL
RIVER LENGTH (km)		0.9	2.9	8.9	15.0	3.0	11.2	2.6	5.2	49.7
JUNE SURVEY										
broods	#	-	-	4	-	-	3	-	-	7
	#/km			0.45			0.27			0.14
creches	#	-	-	-	-	1	1	-	1	3
	#/km					0.33	0.09		0.19	0.06
geese (∑ 1 yr old)	#	-	3	27	3	18	22	24	153	250
	#/km		1.03	3.03	0.20	6.00	1.96	9.23	29.42	5.03
AUGUST SURVEY										
broods	#	-	1	2	-	-	-	-	-	3
	#/km		0.34	0.22						0.06
creches	#	-	-	-	-	-	-	1	-	1
	#/km							0.38		0.02
geese (∑ 1 yr old)	#	-	3	4	2	-	10	13	220	252
	#/km		1.03	0.45	0.13		0.89	5.00	42.31	5.07

TABLE 12. Teslin River - Comparison of the Distribution of Canada Geese on the Wetlands and River Course, 1983. Excludes young of year.

	WETLANDS		RIVER COURSE	
	No. of Individuals	% of Total	No. of Individuals	% of Total
JUNE SURVEY				
paired - with broods/nests	0	0	14	19
paired - no broods/nests	2	1	8	11
single	0	0	3	4
creche	11	6	9	12
group ($\geq$ 3 birds)	164	93	39	54
total geese ($\geq$ 1 yr old)	177	100	73	100
JULY - AUGUST SURVEY				
paired - with broods/nests	0		6	19
paired - no broods/nests	0		2	6
single	0		1	3
creche	0		13	41
group ($\geq$ 3 birds)	305*	100	10	31
total geese ($\geq$ 1 yr old)	305	100	32	100

* aerial estimate, may include creches

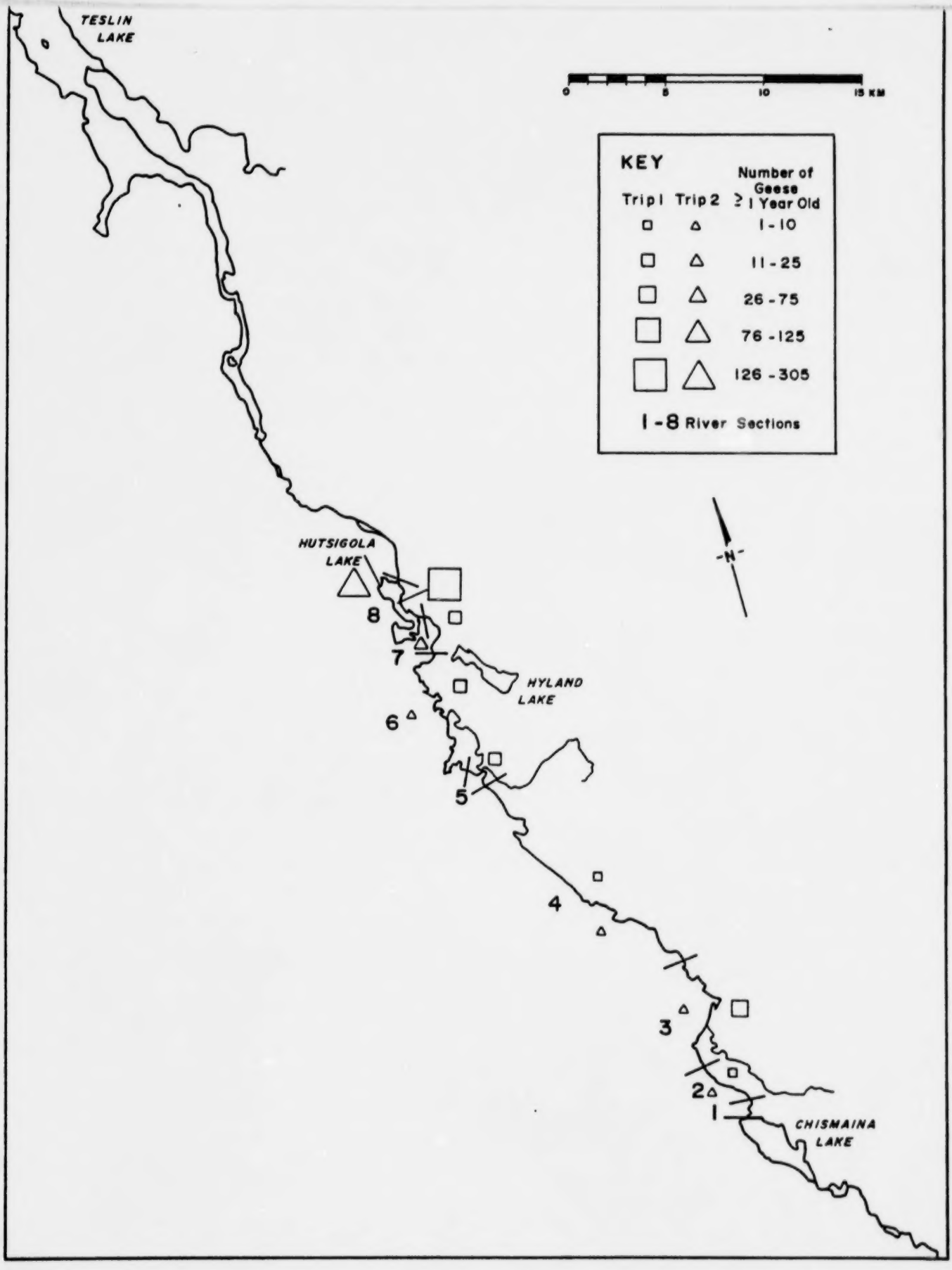

Figure 7 Canada Goose Distribution on the Teslin River, June-August 1983

and 6.0 geese/km respectively (Table 11). Geese were observed within all of the river sections except section 1.

Although the majority of geese occurred on wetlands, most (75%) of these geese were at Hutsigola Lake. Hutsigola Lake is unique. Unlike most wetlands, Hutsigola Lake is an integral part of the river, as the Teslin River flows into it, forming a delta. Unlike Swan, Swift and Morley Lakes into which rivers flow and which are deep, Hutsigola Lake is a Shallow Water.

Trip 2 (7-10 August)

In August the number of Canada Geese had increased 32% from the June estimate. The goose density was 6.78 geese/km (Table 4). Goose distribution was along the general length of the river with the greater abundance of geese again at Hutsigola Lake (Table 11 and Figure 7). The total number of geese at Hutsigola Lake was 220. Section 5 which in June had a relatively high goose density had no geese during the August survey.

The proportion of young of the year to the total geese was unchanged from the June estimate, unlike the decreased proportion of young noted on the Morley and Swift Rivers (Table 4). Most of the goslings occurred in one large creche. Broods occurred in river sections 2 and 3 and the creche occurred in section 7, near Hutsigola Lake.

Ninety-three percent of the geese $\geq$ 1 year old were grouped (Table 8). The predominance of group association was largely attributed to geese on the wetlands, specifically Hutsigola Lake, which is where the majority of geese were observed. Geese on the river course were associated in various group types, predominantly in creches (Table 12).

Large numbers of Canada Geese were noted at Hutsigola Lake during two aerial surveys (Johnston and McEwen 1983b; field notes from flight courtesy of Ducks Unlimited) and the two ground surveys, from late April to mid-August. Results for this site are summarized as follows: as early as 28 April, 186 geese were noted utilizing the lake area (Johnston and McEwen 1983b); 153 geese were counted during ground surveys in late June; approximately 200 were counted during an aerial survey in late July; and 220 geese were counted in mid-August during an aerial survey.

Moult

No flightless geese were noted until 26 June. On that date, one goose among a group of seven was flightless. On 27 June, 20 geese among 25 were presumably flightless as they did not flush with the other five but swam into the emergent vegetation where they were hidden from the observers' sight. These geese were presumably non-breeders. No other flightless geese were noted during the June surveys.

During 28-29 July an abundance of moulted Canada Goose feathers were noted at various sites along the Swift River. At two islands, adjacent to each other at the north end of Swift Lake, (one an exposed sand island and the other a treed island) numerous moulted primaries and secondaries were noted. Also on the Morley River during 30-31 July, at various sites along the upper river sections, moulted goose feathers were found. Geese were flightless on the Morley River during the August survey yet as the geese were largely associated in creches it was not possible to separate the breeders from the non-breeders. In addition, geese which are capable of flight that are with a group of flightless birds will often not fly when approached.

During 7-10 August, on the Teslin River grouped geese with no young (non-breeders) were capable of flight. However, at this time not all breeders or goslings were able to fly. Among 12 goslings, 58% could not fly. From a sample of three breeding pairs, also on the Teslin River, 7-10 August, one pair could not fly.

In summary, the critical period of moult for geese was initiated on 26 June and extended until at least 10 August. Non-breeders or failed breeders moulted earliest followed by a later moult of breeding adults and young of the year.

Stewart, Pelly and MacMillan Rivers

Density

A total of 223 Canada Geese on 17 June and 134 Geese on 16 July was recorded during two aerial surveys of the Stewart, Pelly and MacMillan Rivers. The greatest goose density was noted on the Pelly River, on 17 June, when 73 geese were counted which represented a density of 0.48 geese/km (Table 13). Goose abundance was greatest on the Stewart River, during both surveys, although the density was lower than on the Pelly River on 17 June. The MacMillan River had the lowest goose density yet this river was the shortest river distance surveyed (Table 13).

Paired geese were not abundant on any of the rivers. The most pairs counted was seven on the Pelly River on 17 June. Two broods, one each on the Stewart and the Pelly Rivers, were the only evidence of successful breeding during the June survey. More Canada Goose goslings were counted on 16 July than on 17 June (Table 13). No evidence of breeding was noted on the MacMillan River. Smith (pers. comm.) motoring down the Pelly River and up the MacMillan River in late May 1983 noted 12 Canada Goose pairs on the Pelly River from Ross River to the MacMillan River mouth, and three pairs on the MacMillan River at the Kalzas River mouth.

Canada Goose densities on 16 July on the Stewart and Pelly Rivers had decreased from the June survey estimates, rather than increased, as expected. Flying conditions were not optimal on 16 July and the aircraft had to be flown higher than at the preferred altitude. Consequently we suspect many geese may have been overlooked, thus

TABLE 13. Canada Goose Abundance and Group Type on the Stewart, Pelly and MacMillan Rivers, 1983.

	STEWART RIVER		PELLY RIVER		MACMILLAN RIVER
	17 June	16 July	17 June	16 July	17 June
Total Number	129	99	73	35	21
Total Groups	17	10	16	8	2
Mean Group Size	7.6	9.7	4.4	4.4	10.5
Range in Group Size	2-20	1-25	1-11	1-14	5-16
Total Pairs	4	2	7	3	0
Total Broods	1	2	1	2	0
Total Young	4	26	1	6	0
River Length Surveyed (km)	323	323	153	153	103
Geese/km of River	0.40	0.31	0.48	0.23	0.20

accounting for this decrease in observed goose numbers between surveys.

1982 vs 1983

To compare Canada Goose density estimates of the Stewart and Pelly Rivers between 1982 and 1983, the 1982 estimates were adjusted to include only those geese noted within the 1983 survey area. The mid-June goose estimates were lower in 1982 than in 1983. In mid-June 1982, goose densities on the Stewart and Pelly Rivers were 0.2 geese/km and 0.3 geese/km respectively, approximately 50 and 63% lower respectively, than the 1983 density estimates (Johnston and McEwen 1983a). Mean group sizes in June were larger in 1982 than in 1983: 8.3 vs 7.6 on the Stewart River, and 5.1 vs 4.4 on the Pelly River.

From mid-June to mid-August 1982, goose abundance had increased 448% on the two rivers. However, in 1983 the observed goose abundance in mid-July had decreased from the mid-June estimate, but this observed decrease was likely the influence of poor survey conditions.

Distribution

During the 17 June survey of the Stewart River, geese were generally distributed along the entire river length (Figure 8). Group size ranged from 2-20 individuals, with a mean group size of 7.6 geese. Although the overall goose distribution on 16 July was not clumped, fewer groups were recorded, and two geese concentrations, defined as aggregation of 25 or more geese, were larger than concentrations noted during the June survey. One of the concentrations was comprised of a family group of 6 geese and two groups of 4 and 20 adults. The other concentration was comprised of 2 groups: a creche of 4 adults and 20 young and a group of 25 adults.

On 17 June, 16 groups of geese were observed over 11 locations on the Pelly River, between the mouth of Earn River and the confluence of the Pelly and MacMillan Rivers (Figure 8). Half as many groups were noted on 16 July.

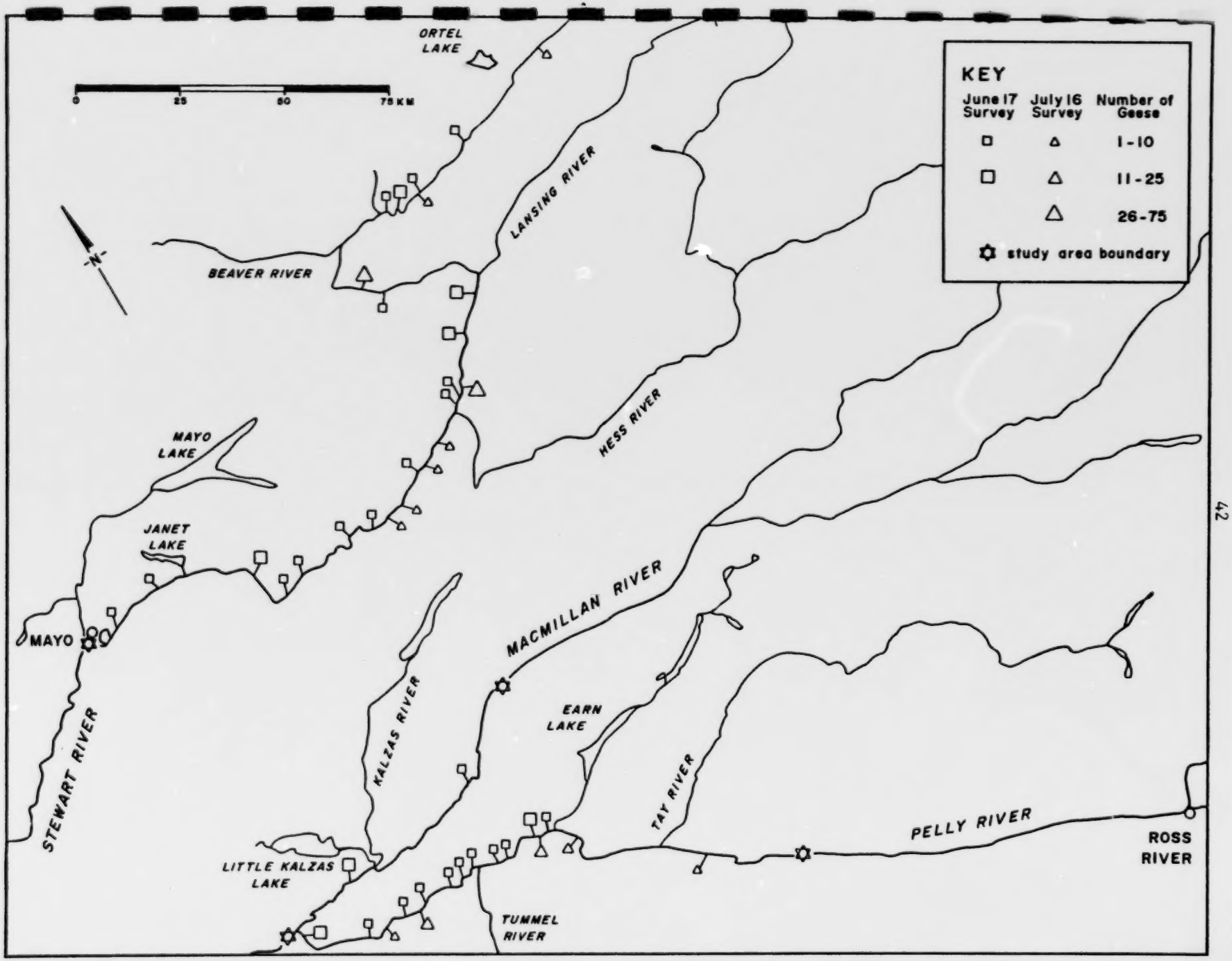

Figure 8. Canada Goose Distribution on the Stewart, Pelly and MacMillan Rivers, June-July 1983

Unlike the Stewart River, no large concentrations (i.e. 26-75 geese) were recorded on the Pelly River during either of the surveys. Mean group size was consistent between surveys (4.4 individuals) and was much smaller than group size on the Stewart River or MacMillan River (Table 13).

Habitat

Water levels of the three rivers were high on 17 June and were presumably at or near flood levels. Geese on the Stewart and Pelly Rivers on 17 June occurred predominantly on the open river channel, often in association with vegetated (treed) islands (Table 14). Nineteen percent of the geese on the Stewart River flushed prior to being sighted and their previous use of habitat was unknown. The number of geese utilizing backwaters and shore bars in June was low compared to the July use of these areas, probably reflecting the limited availability and unfavourable conditions of these habitats caused by high water levels during June.

By 16 July, 99% of the geese noted on the Stewart River were utilizing backwaters. Similarly, a greater proportion of the geese on the Pelly River utilized backwaters in July than in June (Table 14). On the MacMillan River, the two geese groups sighted were associated with shore bars or backwaters.

During 16 July, goose feeding craters were noted at many of the river backwaters. Equisetum spp. (horsetails) was ubiquitous and prolific at the backwaters.

Other Waterfowl

Morley River

Excluding Canada Geese, at least 13 waterbird species were noted on the Morley River and its associated wetlands: one species of loon,

TABLE 14. Distribution of Canada Geese Among Habitat Types on the Stewart, Pelly and MacMillan Rivers, 1983. Percent of total is given in parentheses.

		BACKWATERS	SHORE BARS	ISLAND BARS	LAKES	RIVER CHANNEL	UNKNOWN*
Stewart R.	17 June	12 (9)	10 (8)	-	-	82 (64)	25 (19)
	16 July	98 (99)	-	-	1 (1)	-	-
Pelly R.	17 June	20 (27)	10 (14)	-	-	43 (59)	-
	16 July	15 (43)	4 (11)	2(6)	-	14 (40)	-
MacMillan R.	17 June	5 (24)	16 (76)	-	-	-	-
TOTAL		150 (42)	40 (11)	2(1)	1 (1)	139 (39)	25 (7)

* birds in flight

one species of grebe, five dabbler species and six species of divers (Appendix 7). Blue-winged Teal was a species unique to the Morley River, among the three rivers surveyed.

The more common breeding species found at the 26 wetlands surveyed were American Wigeon, Lesser Scaup and Green-winged Teal (Table 15.) Breeding pairs were more numerous than broods. Only broods of Mallard and goldeneye spp. were observed. Non-breeding bird species (a group which included failed breeders and post-breeding aggregated drakes) which were common in the wetlands included goldeneye spp., Ring-necked Duck, American Wigeon and Mallard. Groups of non-breeders were less common during the July surveys than during the June surveys.

The Morley River exhibited the greatest waterbird breeding pair density (16.56 pairs/km^2) among the three rivers. A total of 25 pairs were recorded of which three were loon or grebe and the remainder was equally represented by dabbling and diving ducks (Table 16).

American Wigeon and Green-winged Teal were the most abundant dabbling duck breeding pairs, and Lesser Scaup represented 90% of the diving duck pairs (Table 16). The high waterbird breeding pair density of the Morley River contrasted with a low brood density which was lowest among the three rivers surveyed. The density of non-breeders, of which Lesser Scaup comprised 52% was 24.17 birds/km^2.

Although several species of waterbirds used the river course, the most abundant species were Harlequin Duck and Common Merganser (Table 17). The richness of waterbird species using the river course increased in July from June, although bird numbers remained low (1.08 birds/km).

The distribution of waterbird pairs among the wetland types (Fen, Marsh, Shallow Water) was not significantly different from the distribution of wetlands into the types (X^2 = .19, 2 d.f., P = .05). Most (52%) of the sampled wetlands were Marshes and the majority of the waterbirds (whether pairs or non-breeders) occurred in Marshes.

TABLE 15. Morley River - Frequency of Occurrence of Waterbirds on 26 Wetlands Surveyed. June - August 1983.

SPECIES	% FREQUENCY OF OCCURRENCE			
	Pairs	Broods	Non-breeders (Trip 1)	Non-breeders (Trip 2)
Common Loon	4	-	-	-
Horned Grebe	4	-	4	-
Green-winged Teal	15	-	4	-
Mallard	4	8	8	8
Blue-winged Teal	4	-	-	-
American Wigeon	19	-	8	8
Ring-necked Duck	-	-	11	-
Lesser Scaup	19	-	4	4
Goldeneye spp.	-	11	15	-

TABLE 16. Morley River - Waterbird Abundance on 26 Wetlands Surveyed, June - August 1983. Density calculated from area of open water and emergent vegetation of all wetlands surveyed.

SPECIES	PAIRS		BROODS		NON-BREEDERS	
	Number	Density (#/km^2)	Number	Density (#/km^2)	Number	Density* (#/km^2)
Common Loon	1	0.66	-		-	
Horned Grebe	2	1.32	-		-	
Green-winged Teal	4	2.65	-		2	0.66
Mallard	1	0.66	2	1.32	5	1.66
Blue-winged Teal	1	0.66	-		-	
American Wigeon	6	3.97	-		8	2.65
Ring-necked Duck	-		-		7	2.32
Lesser Scaup	9	5.96	-		38	12.58
Barrow's Goldeneye	1	0.66	-		-	
Goldeneye spp.	-		3	1.99	13	4.30
TOTAL	25	16.56	5	3.31	73	24.17

* average of two surveys

TABLE 17. Morley River - Waterbird Abundance on the River Course. June - August 1983. Total birds = birds ≥ 1 yr old. densities as #/km are given in parentheses.

SPECIES	7-11 JUNE		30 JULY - 2 AUGUST	
	total birds	pairs	total birds	broods
Green-winged Teal	4 (.08)	-	5 (.10)	1 (.02)
Mallard	-	-	4 (.08)	1 (.02)
Northern Pintail	-	-	3 (.06)	-
American Wigeon	1 (.02)	-	5 (.10)	-
Lesser Scaup	-	-	2 (.04)	1 (.02)
Harlequin Duck	10 (.20)	4 (.08)	-	-
Common Merganser	27 (.55)	1 (.02)	34 (.69)	1 (02)
TOTAL	42 (.86)	5 (.10)	53 (1.08)	4 (.08)

Among the 26 sampled wetlands, 63% had some waterbird use, 52% supported breeding pairs and 22% supported broods. Wetlands in which ten or more waterbirds were observed included #15, #40, #55 and #59 (Figure 2). All of these wetlands supported pairs and non-breeders.

Swift River

The Swift River had the greatest waterbird species richness. At least sixteen species of waterbirds were observed on the river and its associated wetlands. The species included: one loon species, one grebe species, five species of dabblers and at least eight diver species (Appendix 7). Surf Scoters and White-winged Scoters were unique to the Swift River.

The most frequently occurring breeding species (pairs) was Lesser Scaup, followed by Northern Shoveler and Green-winged Teal (Table 18). Although no American Wigeon pairs were observed, wigeon broods were most common, occurring on 13% of the wetlands. The more common species of non-breeding waterbirds were Lesser Scaup, Mallard and American Wigeon (Table 18).

Among the three rivers surveyed, the Swift River wetlands had the lowest waterbird breeding pair density, 5.14 birds/km^2. Lesser Scaup, with a density of 1.87 birds/km^2, represented 36% of the total pairs (Table 19). Total brood density (8.41 broods/km^2) was higher than the observed breeding pair density. The majority of broods were dabbler species, although the species with the highest number of observed broods was Lesser Scaup (Table 19). The density of non-breeders was 61.21 birds/km^2 averaged over the two surveys, and was higher than at either of the other two rivers. Lesser Scaup comprised 51% of the non-breeders. Forty percent of these Scaup were observed

TABLE 18. Swift River - Frequency of Occurrence of Waterbirds on 47 Wetlands Surveyed. June - August 1983.

SPECIES	% FREQUENCY OF OCCURRENCE			
	Pairs	Broods	Non-breeders (Trip 1)	Non-breeders (Trip 2)
Common Loon	-	-	2	-
Red-necked Grebe	4	-	2	-
Green-winged Teal	6	8	8	8
Mallard	4	4	19	8
Northern Pintail	2	-	2	-
Northern Shoveler	6	-	-	-
American Wigeon	-	13	17	13
Ring-necked Duck	-	2	2	-
Lesser Scaup	8	8	21	6
Surf Scoter	-	-	-	2
White-winged Scoter	-	-	2	-
Goldeneye spp.	-	6	4	6
Bufflehead	4	4	4	8
Common Merganser	-	-	-	2

TABLE 19. Swift River - Waterbird Abundance on 47 Wetlands Surveyed June - August 1983. Density calculated from area of open water and emergent vegetation of all wetlands surveyed.

SPECIES	PAIRS		BROODS		NON-BREEDERS	
	Number	Density (#/km^2)	Number	Density (#/km^2)	Number	Density* (#/km^2)
Common Loon	-		-		2	0.23
Red-necked Grebe	2	0.47	-		1	0.12
Green-winged Teal	3	0.70	6	1.40	20	2.34
Mallard	2	0.47	6	1.40	61	7.13
Northern Pintail	1	0.23	-		4	0.47
Northern Shoveler	3	0.70	-		-	
American Wigeon	-		7	1.64	56	6.54
Ring-necked Duck	-		1	0.23	16	1.87
Lesser Scaup	8	1.87	10	2.34	270	31.54
White-winged Scoter	-		-		15	1.75
Goldeneye spp.	-		4	0.93	29	3.39
Bufflehead	3	0.70	2	0.47	42	4.91
Common Merganser	-		-		8	0.93
TOTAL	22	5.14	36	8.41	524	61.21

* average of two surveys

in one group. Other large groups recorded included 17 American Wigeon, 16 Ring-necked Duck and 22 goldeneye.

Waterbird use of the river course was much less than the use of wetlands. Ten species of waterbirds were noted on the river. A group of 100 Surf Scoters was observed on river section 17 which consists of Swan Lake. The more abundant species on the river included Common Merganser, Harlequin Duck, American Wigeon, Mallard, and Lesser Scaup (Table 20). Large bird groups on the river were usually adjacent or proximal to large wetlands.

The distribution of breeding waterbird pairs among the wetland types was again not significantly different (X^2 = 1.24, 3 d.f., P = .05) to the distribution of wetlands into types (Fen, Marsh, Shallow Water, Lake). Seventy percent of the surveyed wetlands were classed as Shallow Water and a corresponding proportion of the waterbirds occurred in Shallow Waters. Sixty percent of the 47 wetlands sampled received waterbird use. Breeding pairs were observed on 28% of the wetlands and broods on 30%. Wetlands where ten or more waterbirds were noted were: #28, #56, #66, #100, #124, #130, #132 and #133 (Figure 3). Waterbirds at these wetlands were usually observed as aggregations of non-breeding ducks.

Teslin River

At least 12 species of waterbirds were observed using the Teslin River and its associated wetlands. The waterbird species included: one loon species, two grebe species, four species of dabblers and at least five diver species (Appendix 7). More than twice as many species were recorded in the wetlands than recorded in the river course. Breeding pairs which occurred most frequently in the surveyed wetlands were diving ducks (Table 21). This was possibly a function of the lateness

TABLE 20. Swift River - Waterbird Abundance on the River Course. June - July 1983. Total birds = birds ≥ 1 yr old. densities as #/km are given in parentheses.

SPECIES	12-19 JUNE		17-21. 28-29 JULY	
	total birds	pairs	total birds	broods
Common Loon	3 (.03)	-	1 (.01)	-
Green-winged Teal	5 (.05)	1 (.01)	-	-
Mallard	12 (.12)	2 (.02)	31 (.32)	-
American Wigeon	18 (.19)	1 (.01)	1 (.01)	-
Lesser Scaup	7 (.07)	2 (.02)	20 (.21)	1 (.01)
Harlequin Duck	14 (.15)	-	-	-
Surf Scoter	100*(1.04)	-	-	-
Goldeneye spp.	8 (.08)	-	-	-
Bufflehead	6 (.06)	2 (.02)	-	-
Common Merganser	35 (.36)	4 (.04)	37 (.38)	-
TOTAL	208 (2.16)	12 (.12)	90 (.94)	1 (.01)

* on Swan Lake, section 17

of the survey relative to dabbling duck breeding and/or the criteria used to define a breeding pair. Lone drakes but not lone hens were criteria for breeding pairs, yet by the time of the survey dabbling duck drakes may already have left their mates and aggregated. The more common breeding diving duck species were Lesser Scaup, Bufflehead and Ring-necked Duck. The estimated waterbird breeding pair density (6.15 pairs/km^2) was comprised mainly of diving ducks, particularly Ring-necked Duck (Table 22).

The estimated waterbird brood density (8.30 broods/km^2) was slightly higher than the estimated breeding pair density. American Wigeon broods were more abundant than those of other species, however, as a group, diving duck broods were more abundant than those of dabbling ducks. The density of non-breeders during the two surveys was 27.67 birds/km^2. The more abundant species of this group were American Wigeon, Mallard and Lesser Scaup (Table 22). There were probably more non-breeding waterbirds than indicated by the August survey, as the wetlands of river sections 7 and 8 could not be surveyed, and during the June survey these wetlands had large numbers of non-breeders.

Common Merganser was the most abundant species on the river course (Table 23). From the June to August surveys, total waterbird numbers on the river decreased 82%.

The use by breeding waterbird pairs of different wetland types (Fen, Marsh, Shallow Water) corresponded to the wetlands' relative availability with no significant preference, (X^2 = .36, 2 d.f., P = .05). Fifty-two percent of the surveyed wetlands were typed as Shallow Waters. Most of the waterbirds, whether pairs, broods or non-breeders, occurred in Shallow Waters. Wetlands where ten or more waterbirds were observed included: #48, #77, #90, #98 and Hutsigola Lake (Figure 4).

TABLE 21. Teslin River - Frequency of Occurrence of Waterbirds on 25 Wetlands Surveyed June - August 1983

SPECIES	% FREQUENCY OF OCCURRENCE			
	Pairs	Broods	Non-breeders (Trip 1)	Non-breeders (Trip 2)
Common Loon	8	-	4	-
Horned Grebe	8	8	4	-
Red-necked Grebe	4	11	8	4
Green-winged Teal	-	4	4	-
Mallard	-	11	27	8
Northern Pintail	-	4	-	-
American Wigeon	4	19	11	-
Ring-necked Duck	15	8	4	4
Lesser Scaup	23	11	23	-
Goldeneye	-	8	4	-
Bufflehead	19	11	-	-

TABLE 22. Teslin River - Waterbird Abundance on 25 Wetlands Surveyed June - August 1983. Density calculated from area of open water and emergent vegetation of all wetlands surveyed.

SPECIES	PAIRS		BROODS		NON-BREEDERS	
	Number	Density (#/km^2)	Number	Density (#/km^2)	Number	Density* (#/km^2)
Common Loon	2	0.61	-		1	0.15
Horned Grebe	1	0.31	3	0.92	1	0.15
Red-necked Grebe	1	0.31	3+	0.92	3	0.46
Green-winged Teal	-		1	0.31	16	2.46
Mallard	-		3	0.92	45	6.92
Northern Pintail	-		1	0.31	-	
American Wigeon	1	0.31	5	1.54	79	12.15
Ring-necked Duck	6	1.85	3	0.92	2	0.31
Lesser Scaup	5	1.54	3	0.92	32	4.92
Goldeneye	-		2	0.61	1	0.15
Bufflehead	5	1.54	3	0.92	-	
TOTAL	21	6.46	27	8.30	179	27.67

\+ includes broods of first survey
* average of two surveys

TABLE 23. Teslin River - Waterbird Abundance on the River Course, June - August 1983. Total birds = ≥ 1 yr old, densities as #/km are given in parentheses.

SPECIES	23-29 JUNE		7-10 AUGUST	
	total birds	pairs	total birds	broods
Green-winged Teal	5 (.10)	-	8 (.16)	-
American Wigeon	2 (.04)	1 (.02)	-	-
Goldeneye spp.	3 (.06)	3*(.06)	-	-
Bufflehead	1 (.02)	1 (.02)	-	-
Common Merganser	38 (.76)	-	1 (.02)	1 (.02)
TOTAL	49 (1.00)	5 (.10)	9 (.18)	1 (.02)

* includes 1 brood

In the first two wetlands (48 and 77), waterbird abundance was largely due to breeding pairs, while in the last three it was due to non-breeding birds. There are numerous large wetlands within the Teslin River valley (Figure 4) which were not surveyed. The abundance of these areas suggest that the Teslin River valley may in fact support large numbers of both breeding and non-breeding waterfowl.

DISCUSSION

Canada Geese

Morley, Swift and Teslin Rivers

Among the three rivers intensively surveyed, the Teslin River had the greatest overall abundance and density of Canada Geese. Breeding pairs, broods and non or failed breeders were all most abundant on the Teslin River. Raveling (1977), in a June survey of B. C. interior on the Churchill River, estimated 0.9 geese/km of river which is: comparable to the Swift River density estimate (0.71 geese/km), higher than the Morley River estimate (0.41 geese/km), and lower than the Teslin River estimate of 5.03 geese/km. Relative to June estimates of goose density on the Stewart, Pelly and Big Salmons Rivers in 1982, goose densities on the Morley, Swift and Teslin Rivers are high. Similarly, the Swift and Teslin River goose density estimates are higher than 1983 estimates for the Stewart, Pelly and South MacMillan Rivers.

Raveling (1977) estimated 0.3 breeding pairs/km of the Churchill River. Canada Goose breeding pair density estimates of the Morley and Swift Rivers (0.12 pair/km) are below Raveling's, while estimates of the Teslin River are comparable (0.32 pairs/km).

The Teslin, Swift and Morley Rivers supported significant numbers of Canada Geese during late spring and summer, 1983. These three rivers collectively supported at least 800 Canada Geese. Using the result of the 1982 study (Johnston and McEwen 1983a) and this study, the Yukon River Basin (Canadian portion) could support approximately 6226 Canada Geese ($\geq$ 1 year old), (Appendix 9). This rough estimate is an average of two values extrapolated from a range of goose densities, representing from 2256 to 10,196 geese.

Canada Goose brood-rearing was restricted to the rivers' courses. Except for one brood on an oxbow adjoining the Swift River, no broods were found in wetlands. Broods tended to be distributed along the entire lengths of the three rivers during June and were more aggregated during July and August. In contrast, Raveling (1977) found brood-rearing habitat on the Churchill River sparse and restricted to a few small sedge marshes on the river. The use of the river course by family groups may make them vulnerable to disturbance and family bond disruption by man-related activities also on the river course. Although adverse effects of human activity on rivers to Canada Goose brood-rearing success on these rivers was not addressed or demonstrated by this study, it should be recognized that the rivers serve as critical habitat for Canada Geese during the broodrearing part of their life cycle. This is particulary important in view of the relatively high goose abundance on the three rivers.

Non-breeding geese used both the river course and wetlands. Large, Shallow Waters were the predominant wetland type utilized. These Shallow Waters were situated on the Swift River upriver of Swift Lake and on the Teslin River including Hutsigola Lake and the area immediately surrounding. The Shallow Waters were characterized by an expanse of open water, a wide rim of emergent vegetation, shallow water depths, extensive basin coverage of submergent vegetation and were contiguous to the river. They offer both feeding and loafing areas with goo visibility to geese. Among these Shallow Waters. Carex rostrata and Hippuris vulgaris were the predominant emergent plant species and the more common submergent plants included species of Potamogeton and Myriophyllum.

Geese on the rivers were often associated with shore bars and backwaters. The occurrence and emergence of these two habitats is a function of two river processes: (1) a slow river current or a change in flow direction causes the deposition of fine silts and mud along the

river's edge or the inside curve of meanders, (2) seasonally declining river water levels continually expose and make available more bar area and new areas of young vegetation growth. The most productive soils in the north result from silt deposition along water courses and commonly support stands of horsetails, sedges, grasses and rushes (Sigma Resource Consultants Ltd. 1975).

The small sample size of Canada Geese precluded rigourous analysis of their distribution and habitat use at the river section level. However, the information was provided in detail for future site specific considerations with respect to potential river development or changes. Specific river sections identified as important to relatively large numbers of geese are discussed later.

The use of river sections by geese was not static during the study period. Specific river sections used by broods in early to mid-June may have been a function of nest locations rather than an active choice of river section by family groups. In this respect, locations of newly hatched broods may be more indicative of general nesting habitat than brood-rearing habitat. Additionally, geese were dispersed among the river sections in June and clumped in their distribution during the July and August surveys, which coincided with the moult phase of the goose life cycle.

Other studies have noted river habitat characteristics and their relationship with Canada Goose abundance. Canada Geese on the Snake River and Churchill River were less abundant or absent from fast flowing, narrow river sections (Craighead and Craighead 1949; Raveling 1977).

Graminoids noted within the study area and grazed by Canada Geese included: Arctophila fulva, Calamagrostis canadensis, Glyceria borealis, Poa pratensis, Carex rostrata and Juncus balticus. Hippuris vulgaris was noted in abundance in areas used by geese and was also

presumably grazed by geese, particularly on the Morely River. Other northern goose studies have documented the consumption of graminoids Hippuris vulgaris by both goslings and geese $\geq$ 1 year old (Mickelson 1975; Bromley 1976; Raveling 1977; Derksen et al 1979; Raveling 1981; Hawkings 1982). On Alaska's north slope sedge species were an important food source to moulting Canada Geese. Sedges and grasses from the north slope had very high values of nitrogen, phosphorus and potassium in early July at the time of the initiation of goose wing moult (Derksen et al 1979).

The month of July was the principal period of wing moult for non-breeding Canada Geese and in this study, compares with northern goose moulting periods reported elsewhere (Sterling and Dzubin 1967; Mickelson 1975; Bromley 1976; Derksen et al 1979). Breeding geese tended to initiate and complete wing moult later. Some breeders were still flightless by 10 August, as were many of the goslings.

Although some Canada Goose populations migrate to moulting areas from their breeding grounds (Kuyt 1966; Sterling and Dzubin 1967; Derksen et al 1979; King and Hodges 1979; Krohn and Bizeau 1979; Zicus 1981), the Morley, Swift and Teslin Rivers provide both moulting and breeding areas for local populations of Canada Geese. Backwaters on the Morley /River were particularly favoured as moulting areas, while large wetlands on the Swift and Teslin Rivers served as moulting areas.

Areas where moulting geese were noticeably abundant were Hutsigola Lake on the Teslin River and Swift Lake on the Swift River. At least 200 geese were at each of these lakes. Swift Lake is a deep, open lake, which is believed to be a characteristic moulting habitat for geese (Dersken et al 1979). Swift Lake, like Hutsigola Lake, is contiguous with the river and has two islands which showed heavy use by geese. Hutsigola Lake is by comparison not deep, however it is a large expanse of open water that is surrounded by other expansive open water areas (see Plate 1). The shallow water areas of Hutsigola Lake offer

Plate I Aerial Photo Showing Significant Area for Canada Geese on the Teslin River, Northern British Columbia.

an abundance of plant food. In addition, the ephereal bars in the lake provide loafing areas with good visibility and which provide relative safety from predators by being completely surrounded by water.

Sterling and Dzubin (1967) gave as characteristics of Canada Goose moulting areas: (1) low human and natural predator populations, (2) unlimited visibility, (3) available areas for escape and (4) no possible competition with breeders for food. Although the last criterion does not apply to moult areas of the Morley, Swift and Teslin Rivers, the first three characteristics are met. The large areas of open water on the lakes provide areas for escape; visibility on the lakes is unhindered; and since there are no roads to these moult areas, human access is limited. However, helicopter activity occurred to and from an island in Swift Lake which was used by moulting geese during the 1983 field season.

The moulting period is a critical time for geese, as for other waterfowl. During wing moult, geese experience a negative energy balance (Williams and Kendeigh 1982). To compensate for the increased energy requirement for feather growth, moulting Canada Geese can spend as much as 71-98% of their time feeding (Derksen et al 1979). Disturbance can adversely affect the critical energy requirements of moult by interrupting feeding activity and by causing behavioural or physiological responses which involve additional expenditures of energy.

Employing the most conservative estimate of breading pairs of Canada Geese (only those pairs with broods plus the two pairs with a nest), there were at least 25 successful breeding pairs among the three rivers intensively surveyed. Canada Goose nesting success can be affected by spring weather conditions (Barry 1966; Mickelson 1975; Bromley 1976; Davies and Cooke 1983), age of breeding geese (Raveling 1981), predators and flooding (Craighead and Craighead 1949; Klopman 1958). Although it is only speculation at this point, we believe that

floodwaters of northern rivers may have a significant effect on the reproductive success of geese. We estimated the mean time of hatch of goslings to be 8 June in 1983 (Appendix 8). Peak river levels measured on the Swift River occurred on 2 June. Any goose nests in riparian areas susceptible to flooding would have been vulnerable to destruction. Observations from this study suggest that the upper sections of the Swift River (upriver of Swan Lake) and particularly the upper sections of the Morley River, seasonally flood their banks and adjacent wetlands each spring. The magnitude and timing of flooding would then be critical to the survival of goose nests. It would be advantageous for geese to breed as early as possible in the season in order to hatch a brood prior to spring flooding. Craighead and Craighead (1949) reported 25% of Canada Goose nests on the Snake River in Wyoming were destroyed by river floodwaters. Sterling (pers. comm.) believed annual river flooding could be a significant cause of goose nest failures on northern rivers.

The time of Canada Goose gosling hatch for most broods noted on the Morley, Swift and Teslin Rivers was early to mid-June. This date compares with goose hatch in the Churchill River Basin (Raveling 1977) but is later than the May hatch time on Admiralty Island in southeast Alaska for B. c. fulva (Lebeda and Ratti 1983). It is earlier than hatch time in July at Eskimo Point, Northwest Territories (MacInnes 1962) or the west coast of Alaska where Mickelson (1975) noted young broods from late June to early July.

Working back to calculate the time of egg laying, assuming approximately 26 days for incubation (MacInnes 1962; Michelson 1973; Bromley 1976), most incubation on the Morley, Swift and Teslin Rivers was initiated in mid-May. Egg laying may take as long as a week and Canada Geese may arrive at nesting areas but not initiate nesting for 10 - 24 days, depending upon the spring weather conditions (Bromley 1976; Raveling 1978). Therefore Canada Geese could arrive at their nesting grounds on the Morley, Swift and Teslin Rivers from late April

to early May. On 29 April of 1983 a total of 415 Canada Geese were counted on open water sites within the Yukon River Basin in northern British Columbia (Johnston and McEwen 1983b). On the Teslin River alone (above Teslin Lake), 156 geese were counted.

Stewart, Pelly and MacMillan Rivers

Although there was some evidence of Canada Goose brood-rearing on the Stewart and Pelly Rivers, both in 1982 and 1983, the rivers were primarily used by non-breeding geese. Goose abundance increased from June to mid-August in 1982 on the Stewart and Pelly Rivers. This increase was probably due to the use of these rivers by local goose populations for moulting and for post-moult or pre-migration aggregations. The same density increases were not observed from June to mid-July in 1983, but this apparent lack of increase was likely a result of poor survey conditions in the latter survey. In addition, the large increase in abundance and high total count of Canada Geese on the rivers in mid-August 1982 may have been the result of a late spring and an unusually large number of failed breeders as spring thaw and break-up in 1982 was atypically late. The effect of a late spring on breeding geese can mean a reduction in available goose nesting habitat and reduced productivity (Barry 1966; Mickelson 1975; Bromley 1976; Dau and Mickelson 1979; Malecki et al 1981; Davies and Cooke 1983).

The Canada Geese utilizing the Pelly, Stewart and MacMillan Rivers for moulting and post-moult aggregations likely represented a local population of geese. Based on our two years' results of Canada Geese investigations we believe that geese predominantly utilize headwater rivers or rivers of first, second and third order for nesting and early brood-rearing. Failed breeders or immature non-breeders on the Pelly, Stewart and MacMillan Rivers likely originate from the respective tributaries of these rivers. Increases in the number of young of the year on the larger rivers may be a function of the broods progressively

moving downriver on the tributaries. P. Denison (pers. comm.) investigated Canada Goose abundance on the lower section of the Nisutlin River in the south-central Yukon Territory, and found no nests and found no broods until July when more than 10 broods were recorded. She postulated that the broods had originated further upriver and had gradually travelled downstream. Craighead and Craighead (1949) also noted a gradual shift downriver of Canada Goose broods on the Snake River.

During both 1982 and 1983, geese observed on the Stewart and Pelly Rivers displayed a preference for backwaters. Evidence of feeding (feeding craters) was observed at backwaters and shore bars either at or near goose sightings. Equisetum spp. was commonly noted at bars and backwaters used by geese during both years. Johnston and McEwen (1983a) suggested that the predominance of new growth Equisetum spp. in backwaters, in conjunction with an area of calm water adjacent to the river, good visibility of the river, and exposed, bare mudflats, provided suitable habitat for geese for loafing and feeding.

Lortie and Jack (1975) noted the heavy use by Canada Geese of Equisetum spp. on the Pelly and MacMillan Rivers. Prevett et al (1979) documented the utilization of Equisetum by Lesser Snow Geese and Canada Geese in the Hudson Bay Lowlands during spring and fall migration and during the annual moult. Thomas and Prevett (1982) found that new growth aerial stems and rhizomes of Equisetum fluviatile contained 22% and 14% protein respectively, and they pointed out that protein with phorphorus is utilized by geese in feather development.

Other Waterfowl

The breeding duck population estimates of the Morley, Swift and Teslin Rivers compare with estimates from the North Canol Road area in the south-eastern Yukon Territory (Dennington et al 1983) yet were below estimates from the south-central Yukon Territory (Johnston and

McEwen 1983a) and northern Sweden (Danell and Sjoberg 1979). Dennington et al (1983) estimated overall densities of 56 duckskm^2 in June 1981 (which is comparable to the results of this study), and 22 ducks/km^2 in June 1982. In northern Sweden, an area of similar habitat, duck density was 54 pairs/km^2 (Danell and Sjoberg 1979). During an atypically late spring, Johnston and McEwen (1983a) estimated duck breeding pair density on wetlands on two rivers in the south-central Yukon Territory at 44.38 pairs/km^2 and 15.31 pairs/km^2, on the Pelly and Big Salmon Rivers respectively. Although the latter estimates were higher than the waterbird density estimates of the Morley, Swift and Teslin Rivers, they were considered lower than average due to the atypically late spring thaw in 1982.

Wetland areas within the Yukon River Basin are abundant and cumulatively may represent significant breeding (and moulting) areas for waterfowl. In addition, during a prairie drought, northern wetlands serve as the breeding grounds or summering area for drought-displaced ducks (Hansen and McKnight 1964) and thus are critical for ducks.

The estimated density of non-breeding ducks was relatively high on the Swift River. This density estimate exceeded an estimate for the Big Salmon River and was slightly below an estimate for the Pelly River (Johnston and McEwen 1983a). Numbers of non-breeding ducks remained high in July on the Swift River wetlands, largely because of one group of 110 moulting scaup on wetland #100.

A decline in numbers of non-breeders from the June to July-August surveys was noted on the wetlands of the Morley and Teslin Rivers. The waterbird groups noted in June likely represented birds aggregated prior to leaving for moulting areas (Salomonsen 1968).

Although the Teslin River survey of August did not include Hutsigola Lake, we believe the lake and surrounding wetlands may have supported large numbers of ducks as found during the June survey.

The most abundant and ubiquitous waterbird species at the three rivers surveyed was Lesser Scaup. Other abundant species were Mallard, American Wigeon, Green-winged Teal, Ring-necked Duck, Bufflehead and goldeneye spp. Lesser Scaup has been reported to be one of the mort abundant waterfowl species in various areas of the Yukon Territory (Soper 1954; Dennington et al 1983; Johnston and McEwen 1983a).

The distribution of waterfowl among the river wetlands was not influenced by the wetland types, in other words, distinct preferences for certain wetland types were not found. All available wetland types were utilized by waterfowl. Marsh and Shallow Water were the major wetland types available and the major types utilized.

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APPENDICES

APPENDIX 1. Bird Species Observed During Ground Surveys on the Morley-Swift and Teslin Rivers, June - August 1983. * denotes evidence of breeding (nest, territorial male, flightless young of year).

SPECIES		MORLEY RIVER	SWIFT RIVER	TESLIN RIVER
Common Loon	*Gavia immer*	+*	+	+*
Horned Grebe	*Podiceps auritus*	+		+*
Red-necked Grebe	*Podiceps grisegena*		+	+*
Canada Goose	*Branta canadensis*	+*	+*	+*
Green-winged Teal	*Anas crecca*	+*	+*	+*
Mallard	*Anas platyrhynchos*	+*	+*	+*
Northern Pintail	*Anas acuta*	+	+	+*
Blue-winged Teal	*Anas discors*	+		
Northern Shoveler	*Anas clypeata*		+	
American Wigeon	*Anas americana*	+	+*	+*
Ring-necked Duck	*Aythya collaris*	+	+*	+*
Lesser Scaup	*Aythya affinis*	+*	+*	+*
Harlequin Duck	*Histrionicus histrionicus*	+*	+	
Surf Scoter	*Melanitta perspicillata*		+	
White-winged Scoter	*Melanitta fusca*		+	
Common Goldeneye	*Bucephala clangula*		+	
Barrow's Goldeneye	*Bucephala islandica*	+	+	
Goldeneye spp.	*Bucephala* spp.	+*	+*	+*
Bufflehead	*Bucephala albeola*	+	+*	+*
Common Merganser	*Mergus merganser*	+*	+	+
Bald Eagle	*Haliaeetus leucocephalus*	+*	+*	+
Sharp-shinned Hawk	*Accipiter striatus*	+		+
Northern Goshawk	*Accipiter gentilis*	+		
Red-tailed Hawk	*Buteo jamaicensis*	+	+	+
American Kestrel	*Falco sparverius*		+	
Osprey	*Pandion haliaetus*			+
Spruce Grouse	*Dendragapus canadensis*			+
Sora	*Porzana carolina*			+
American Bittern	*Botaurus lentiginosus*		+	
Semi-palmated Plover	*Charadrius semipalmatus*	+	+	+
Greater Yellowlegs	*Tringa melanoleuca*		+	+
Lesser Yellowlegs	*Tringa flavipes*	+	+*	+*
Solitary Sandpiper	*Tringa solitaria*	+	+	+*
Spotted Sandpiper	*Actitis macularia*	+*	+*	+*
Semi-palmated Sandpiper	*Calidris pusilla*	+		
Least Sandpiper	*Calidris minutilla*	+	+	
Baird's Sandpiper	*Calidris bairdii*		+	
Common Snipe	*Gallinago gallinago*	+*	+	+
Red-necked Phalarope	*Phalaropus lobatus*	+		
Long-billed Dowitcher	*Limnodromus scolopaceus*		+	

continued . . .

APPENDIX 1 . continued . . .

SPECIES		MORLEY RIVER	SWIFT RIVER	TESLIN RIVER
Bonaparte's Gull	*Larus philadelphia*		+	+
Mew Gull	*Larus canus*	+*	+	
Herring Gull	*Larus argentatus*		+	+
Arctic Tern	*Sterna paradisaea*	+*	+	+
Great Horned Owl	*Bubo virginianus*		+	
Common Nighthawk	*Chordeiles minor*		+	+
Belted Kingfisher	*Ceryle alcyon*	+	+	+*
Three-toed Woodpecker	*Picoides tridactylos*			+*
Northern Flicker	*Colaptes auratus*		+	
Olive - sided Flycatcher	*Contopus borealis*		+	+
Empididae		+	+	+
Tree Swallow	*Tachycineta bicolor*	+	+	+
Violet-green Swallow	*Tachycineta thalassina*			+
Bank Swallow	*Riparia riparia*	+*	+	+
Cliff Swallow	*Hirundo pyrrhonota*	+	+	+
Barn Swallow	*Hirundo rustica*	+	+	+
Rough-winged Swallow	*Stelgidopteryx serripennis*	+*		
Gray Jay	*Perisoreus canadensis*	+*	+	+
Common Raven	*Corvus corax*	+	+	+
Black-capped Chickadee	*Parus atricapillus*		+	
Boreal Chickadee	*Parus hudsonicus*	+	+	+
Red-breasted Nuthatch	*Sitta canadensis*	+		
Ruby-crowned Kinglet	*Regulus calendula*	+	+	+
Swainson's Thrush	*Catharus ustulatus*	+	+	+
Hermit Thrush	*Catharus guttatus*		+	
American Robin	*Turdus migratorius*	+	+	+
Varied Thrush	*Ixoreus naevius*		+	+
Water Pipit	*Anthus spinoletta*		+	
Bohemian Waxwing	*Bombycilla garrulus*	+	+	+
Northern Shrike	*Lanius excubitor*			+
Tennessee Warbler	*Vermivora peregrina*	+		
Yellow-rumped Warbler	*Dendroica coronata*	+	+	+
Blackpoll Warbler	*Dendroica striata*	+	+	
Yellow Warbler	*Dendroica petechia*		+	
Northern Waterthrush	*Seiurus noveboracensis*	+	+	+
Common Yellowthroat	*Geothylpis trichas*	+	+	+*
Wilson's Warbler	*Wilsonia pusilla*	+	+	+
American Tree Sparrow	*Spizella arborea*	+	+	+
Chipping Sparrow	*Spizella passerina*		+	+
Savannah Sparrow	*Passerculus sandwichensis*	+	+	
Fox Sparrow	*Passerella iliaca*	+	+	

continued . . .

APPENDIX 1. continued . . .

SPECIES		MORLEY RIVER	SWIFT RIVER	TESLIN RIVER
Song Sparrow	*Melospiza melodia*	+*	+	+*
White-crowned Sparrow	*Zonotrichia leucophrys*	+	+	+
Dark-eyed Junco	*Junco hyemalis*	+	+	+
Red-winged Blackbird	*Agelaius phoeniceus*	+	+*	+
Rusty Blackbird	*Euphagus carolinus*	+	+*	+
Pine Grosbeak	*Pinicola enucleator*	+		
White-winged Crossbill	*Loxia leucoptera*	+*	+	+
Pine Siskin	*Carduelis pinus*	+		+

APPENDIX 2. Mammal Observations on the Morley River, June - August 1983.

SPECIES	DATE	RIVER SECTION	NUMBER OF INDIVIDUALS
Moose	8-6	3*	1 adult*
(*Alces alces*)	9-6	3	1 yearling
	31-7	3	1 calf
	31-7	5	1 yearling
Beaver	9-6	3	1
(*Castor canadensis*)	10-6	6	2
	30-7	2	1
Lynx	30-7	3	1
(*Felis canadensis*)	31-7	3	1 (heard only)
Wolf (*Canis lupus*)			tracks only
Caribou (*Rangifer tarandus*)			tracks only

* denotes wetland observation

APPENDIX 3. Mammal Observations on the Swift River, June - July 1983.

SPECIES	DATE	RIVER SECTION	NUMBER OF INDIVIDUALS
Moose (*Alces alces*)	16-6	10	1 cow + 1 calf
	16-6	11	1 bull
	16-6	10*	1 cow
	16-6	10*	1 cow
	16-6	6*	1 cow + 1 calf
	17-6	13	1 cow
	17-6	13	1 cow + 1 calf
	17-6	13*	1 bull
	17-6	13*	1 bull, 1 cow
	17-6	13*	1 adult
	17-6	13*	1 cow
	17-6	13*	1 cow + 1 calf
	18-6	15	1 bull
	18-6	15	1 cow + 1 calf
	18-6	15	1 cow + 1 calf
	18-6	15	1 cow + 1 calf
	18-6	16	1 cow + 1 calf
	18-7	3	1 cow + 2 calves
	21-7	8	1 cow + 2 calves
	21-7	8	1 cow + 1 calf
	21-7	8	1 cow + 1 calf
	21-7	10*	1
Beaver (*Castor canadensis*)	13-6	1*	1
	15-6	6	1
	15-6	6*	1
	15-6	7*	1
	16-6	10	2
	17-6	13*	1
	18-7	1*	1
	18-7	3	2
	19-7	5	1
	19-7	6	1
	19-7	5*	1
Muskrat (*Ondrata zibethicus*)	15-6	6*	1
	15-6	6	1
	20-7	7*	1
Porcupine (*Erethizon dorsatum*)	20-7	6	1

continued . . .

APPENDIX 3. continued . . .

SPECIES	DATE	RIVER SECTION	NUMBER OF INDIVIDUALS
Wolf (*Canis lupus*)			tracks only
Grizzly Bear (*Ursus arctos*)			tracks only

* denotes wetland observation

APPENDIX 4. Mammal Observations on the Teslin River June - August 1983.

SPECIES	DATE	RIVER SECTION	NUMBER OF INDIVIDUALS
Moose	23-6	2	1 cow
(*Alces alces*)	24-6	3*	1 cow
	24-6	4*	1 cow + 1 calf
	24-6	4*	1 cow + 1 calf
	25-6	4*	1 cow
	25-6	5*	1 unidentified
	25-6	5*	1 bull
	26-6	6*	1 bull
	27-6	8*	1 cow. 1 calf. 1 yearling
	27-6	8*	1 cow
	27-6	8*	1 bull
	27-6	8*	1 cow + 1 calf
	27-6	8*	2 bull yearlings
	27-6	8*	1 cow
	27-6	8*	1 cow
	27-6	8*	1 bull
	27-6	8*	1 cow + 1 calf
	7-8	2	1 cow + 1 calf
	8-8	5	1 cow
	8-8	4*	1 cow + 1 calf
	8-8	4*	1 yearling
Beaver	23-6	1	1
(*Castor canadensis*)	23-6	3	1
	23-6	3	1
	25-6	4	1
	26-6	6	1
	26-6	6	1
Muskrat	7-8	2	1
(*Ondrata zibethicus*)	10-8	6*	1

* denotes wetland observations

APPENDIX 5. Graminoids Noted Along the Morley. Swift and Teslin Rivers, July - August 1983.

SPECIES	MORLEY	SWIFT	TESLIN
Agrostis scabra			+
Arctagrostis arundinacea	+		+
Arctophila fulva	+*	+*	+*
Bromus ciliatus			+
Calamagrostis canadensis	+		+*
C. neglecta			+
Deschampsia caespitosa	+		
Glyceria borealis			+*
Poa pratensis			+*
Poa sp.			+
Puccinellia sp.			+
Carex aquatilis	+	+	
C. canescens			+
C. physocarpa	+	+	
C. rostrata			+*
Eleocharis acicularis			+
Juncus balticus	+	+*	
J. filiformis			+

* · denotes evidence of goose graze

APPENDIX 6. Gauge Heights of Water Levels of the Swift River 1983.

DATE	GAUGE HEIGHTS*(m) Swift River°
May 5	.860
May 20	.997
May 25	1.082
May 31	2.289
June 5	2.168
June 10	1.888
June 15	1.577
June 20	1.566
MAXIMUM (2 June)	2.761

* Water Survey of Canada, 1983 field data

° measurements from Swift River at Smart River station

APPENDIX 7. Presence of Waterbird Species (other than geese) in the Morley, Swift and Teslin River Valleys. June - August. 1983.

SPECIES	MORLEY		SWIFT		TESLIN	
	River	Wetlands	River	Wetlands	River	Wetlands
Common Loon		x	x	x		x
Horned Grebe		x				x
Red-necked Grebe				x		x
Green-winged Teal	x		x	x	x	x
Mallard	x		x	x		x
Northern Pintail	x			x		x
Blue-winged Teal		x				
Northern Shoveler				x		
American Wigeon	x	x	x	x	x	x
Ring-necked Duck		x		x		x
Lesser Scaup	x	x	x	x		x
Harlequin Duck	x		x			
Surf Scoter			x			
White-winged Scoter				x		
Common Goldeneye			x			
Barrow's Goldeneye		x				
Goldeneye spp.		x	x	x	x	x
Bufflehead			x	x	x	x
Common Merganser	x		x	x	x	

APPENDIX 8. Estimated Mean Time of Hatch of Canada Goose Goslings, 1983. From observed broods which could be confidently aged.

	DATE OF OBSERVATION	AGE CLASS*	APPROX. AGE	TIME OF HATCH	MIDPOINT OF HATCH
Morley River	9 June	6 eggs		9 June	10 June
	10 June	Ia	1 day	9 June	9 June
	11 June	Ia	1-7 days	4-11 June	7 June
Swift River	13 June	Ia	2 days	11 June	11 June
	14 June	Ia	3-5 days	9-11 June	10 June
Teslin River	24 June	Ic	21 days	3 June	3 June
MEAN TIME OF HATCH					8 June

* Yocom and Harris (1965)

APPENDIX 9. Extrapolations of Canada Goose ($\geq$ 1 year old) Abundance on 51 Rivers Within the Entire Yukon River Basin, Yukon.

RIVER	ESTIMATED LENGTH (km)	ESTIMATED NO. OF GEESE	
		High[1]	Low[2]
Beaver	95	228	38
Big Salmon[3]		4	4
N. Big Salmon	75	180	30
S. Big Salmon	60	144	24
Donjek	170	408	68
Gladys	75	180	30
Hess	270	648	108
Hoole	60	144	24
Jennings	115	276	46
Kedahda	50	120	20
Klondike	140	336	56
Klotassin	100	240	40
Kluane	75	180	30
Lansing	50	120	20
Lapie	60	144	24
Little Salmon	50	120	20
MacMillan[4]	140	28	28
N. MacMillan[4]	110	22	22
S. MacMillan[4]	160	32	32
Magundy	80	192	32
McNaughton	40	96	16
McNeil	50	120	20
McQueston	60	144	24
N. McQuesten	70	168	28
S. McQuesten	65	156	26
Morley[5]		32	32
Nadaleen	100	240	40
Nisling	150	360	60
Nisutlin	200	480	80
Nordenskiold	120	288	48
Pelly (Ross R. - Yukon R.)[6]		46	46
Pelly (source - Ross R.)	230	552	92
Prevost	80	192	32
Primrose	25	60	10
Riddell	55	132	22
Rogue	130	312	52
Rose	70	168	28
Sixty Mile	115	276	46
Smart	50	120	20
Stewart[7]		66	66
Swift[8]		91	91

continued . . . .

APPENDIX 9. continued . . .

RIVER	ESTIMATED LENGTH (km)	ESTMATED NO. OF GEESE High[1]	Low[2]
Takhini[9]	80	2	2
Tay	110	264	44
Teslin[10]		350	350
Teslin (below Teslin Lk.)[11]	160	19	19
Thirty MIle	35	84	14
Watson	90	216	36
White	190	456	76
Wolf	130	312	52
Woodside	60	144	24
TOTAL ESTIMATED GEESE		10,196	2256
MEAN NUMBER		6226	

1 density estimate of 2.4 geese ($\geq$ 1 year old)/km of river, mean density of June estimates of the Morley, Swift and Teslin Rivers
2 density estimate of 0.4 geese/km of river, low density estimate from the Morley River, June 1983
3 1982 results (Johnston and McEwen,1983a)
4 1983 results, this study
5 1983 results, this study
6 1982 results (Johnston and McEwen, 1983a)
7 1982 results (Johnston and McEwen, 1983a)
8 1983 results, this study
9 density estimate of 0.02 geese/km, fromBig Salmon River estimate, 1982
10 1983 results, this study
11 Stewart River density estimate,1982

NOTE: estimate of goose abundance is rough, some river estimates may seem too high and correspondingly, some river estimates may seem too low.